T.O. 38G2-54-3

TECHNICAL MANUAL

OVERHAUL

GAS TURBINE ENGINE ASSEMBLY

MODEL 502-7D

(BOEING)

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INTRODUCTION

This publication comprises the overhaul instructions for the Gas Turbine Engine Model 502-7D manufactured by Boeing Airplane Company, Seattle, Wash. Frequent reference is made to the Table of Limits, in Section VI. Use this table for all operations involving measurement or use of gages.

Figure 1-1 shows the major sections of the engine and their relationship to each other. The engine is functionally divided into two basic sections, a gas producer section and a two-stage compressor assembly. To facilitate disassembly and repair, the gas producer section is further divided into the rotor section, burner section, sump and base section, and accessory drive assembly. Additional components installed on the engine include an inlet silencer assembly, a nozzle ring assembly, an exhaust collector assembly, and an air flow control assembly.

For reference, the gas producer end of the engine is considered to be the front, with left and right identified looking forward. Looking forward, rotation of all turbine wheels is counterclockwise.

SECTION I

GENERAL DESCRIPTION

1-1. APPLICATION.

1-2. The model 502-7D gas turbine engine is comprised of a gas producer section and a two-stage compressor assembly and is used to provide compressed air for ground maintenance of B-52 airplanes and for starting B-52 airplane engines. In service, the gas turbine engine is installed in a power package which contains two air inlet compartments, control and instrument panels, and supplemental fuel, oil and electrical system components. The power packages are installed in pairs on a trailer to make up the Gas Turbine Pneumatic Power Set Assembly, Part Number F52372.

1-3. PRINCIPLES OF OPERATION.

1-4. (See figure 1-2.) The gas turbine engine is a type of internal combustion engine that produces power by a continuous and self-sustaining process of compression, combustion, expansion, and exhaust. Air is compressed by a centrifugal compressor and mixed with atomized fuel in two through-flow type combustion chambers. As the fuel burns, the resultant gases expand through two successive turbine wheels which convert heat energy into useful power. As shown in figure 1-2, compressed air is produced in the following manner:

a. Air enters the engine through an inlet silencer assembly and passes into a centrifugal compressor where the pressure is increased to more than three atmospheres.

b. The air is then discharged into two burner chambers where atomized fuel is added and combustion takes place. About one-fourth of the air is used for combustion. The air in excess of that required for combustion surrounds the flame inside the burner liner assembly and surrounds the liner assembly itself, protecting the metal parts of the burners and the nozzle box assembly from the 1982°C (3600°F) temperature of combustion.

c. Electrical ignition is necessary only during starting. If only one burner should fire, its flame is conducted through a crossfire tube to induce combustion in the other chamber. After the engine reaches idling speed, the burning process is self-sustaining throughout the entire operating range.

d. The combustion gas and surrounding air leaving the two burners mix in the nozzle box assembly, with the gas temperature stabilizing at 843°C (1550°F). At this point the gas expands through a ring of fixed vanes (nozzles) which direct it against the blades of the turbine wheel of the balancing assembly, causing the balancing assembly (including the turbine wheel shaft and impeller) to rotate at a rated maximum speed of 36,500 rpm. Thus, the balancing assembly impeller provides a continuous supply of compressed air to the burners.

e. Leaving the balancing assembly turbine wheel, the gas expands through a second ring of fixed vanes. These vanes direct the gas against the blades of the turbine wheel of the rotor assembly, rotating the rotor assembly (including the turbine wheel, shaft, and two rotor assembly impellers) at a rated speed of 27,000 rpm.

f. After passing through the turbine wheel of the rotor assembly, the gas is gathered in an exhaust collector assembly and discharged to atmosphere. When the gas has reached the exhaust collector assembly, its temperature has dropped to 649°C (1200°F), which is indicative of a normal maximum operating temperature of 843°C (1550°F) at the nozzle box assembly.

g. Since the turbine wheels of the gas producer section and two-stage compressor assembly are mechanically separate, their speeds are independent. The effect produced is similar to that of an hydraulic torque converter. The rotor assembly of the two-stage compressor assembly can change speed according to load while the balancing assembly of the gas producer section remains at rated speed.

h. The sequence of operation of the two-stage compressor assembly is as follows: Air enters the compressor inlet and is partially compressed by the first-stage compressor impeller.

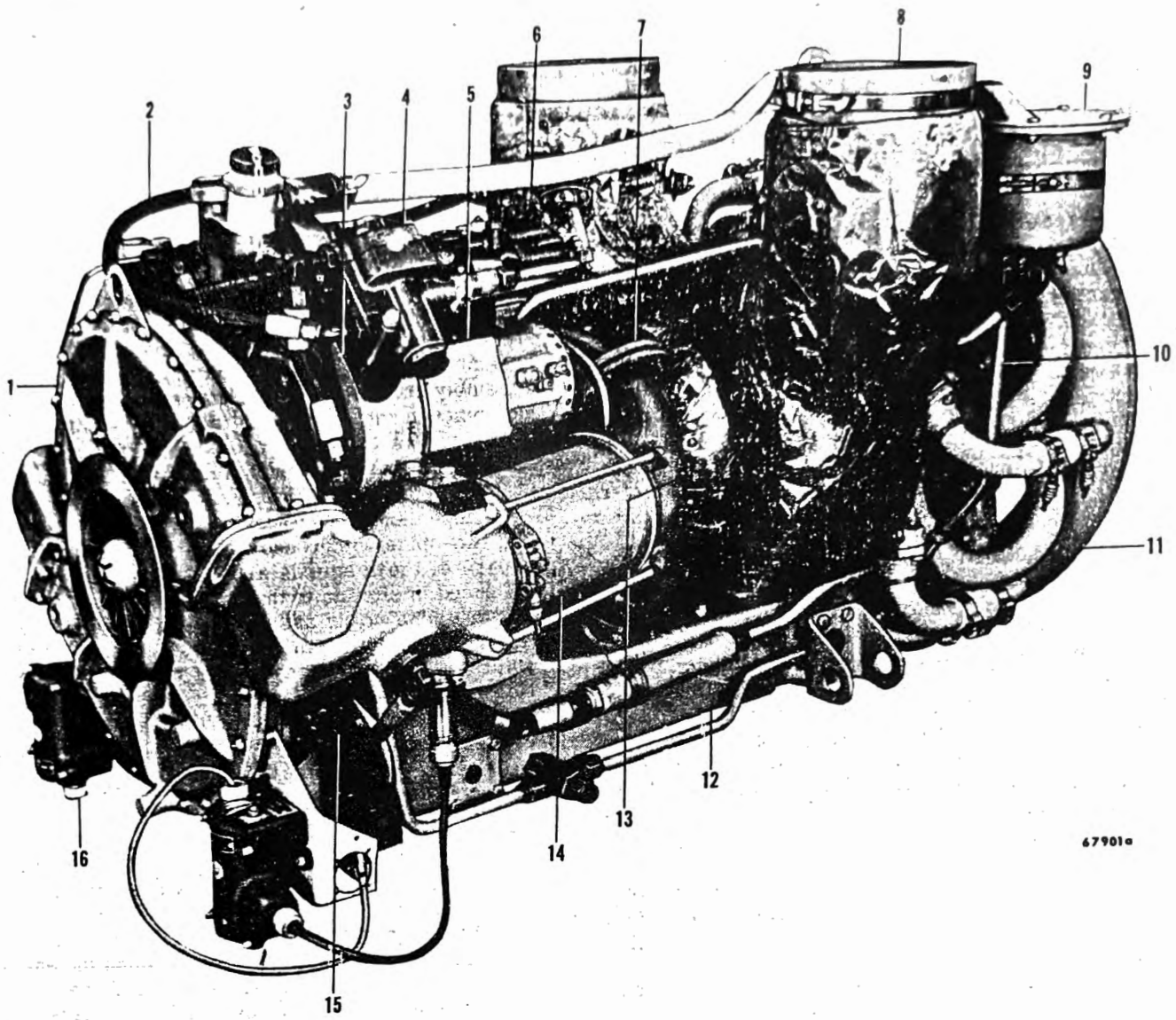
NOTE

Although the engine assembly does not include an inlet silencer assembly at the compressor inlet, both a silencer and an oil cooler are installed in the power package in which the engine is mounted in service. Air enters the power package through the inlet silencer assembly and is directed through the oil cooler and into the two-stage compressor assembly.

The air is conducted through first-stage tube assemblies to the second-stage impeller where it is further compressed. The air then passes through the second-stage tube assemblies to an air collector assembly, from which it is discharged through an air flow control assembly. The air flow control assembly maintains compressor output within its most satisfactory operating range, regardless of demand, and prevents compressor surge by dumping excess air to atmosphere.

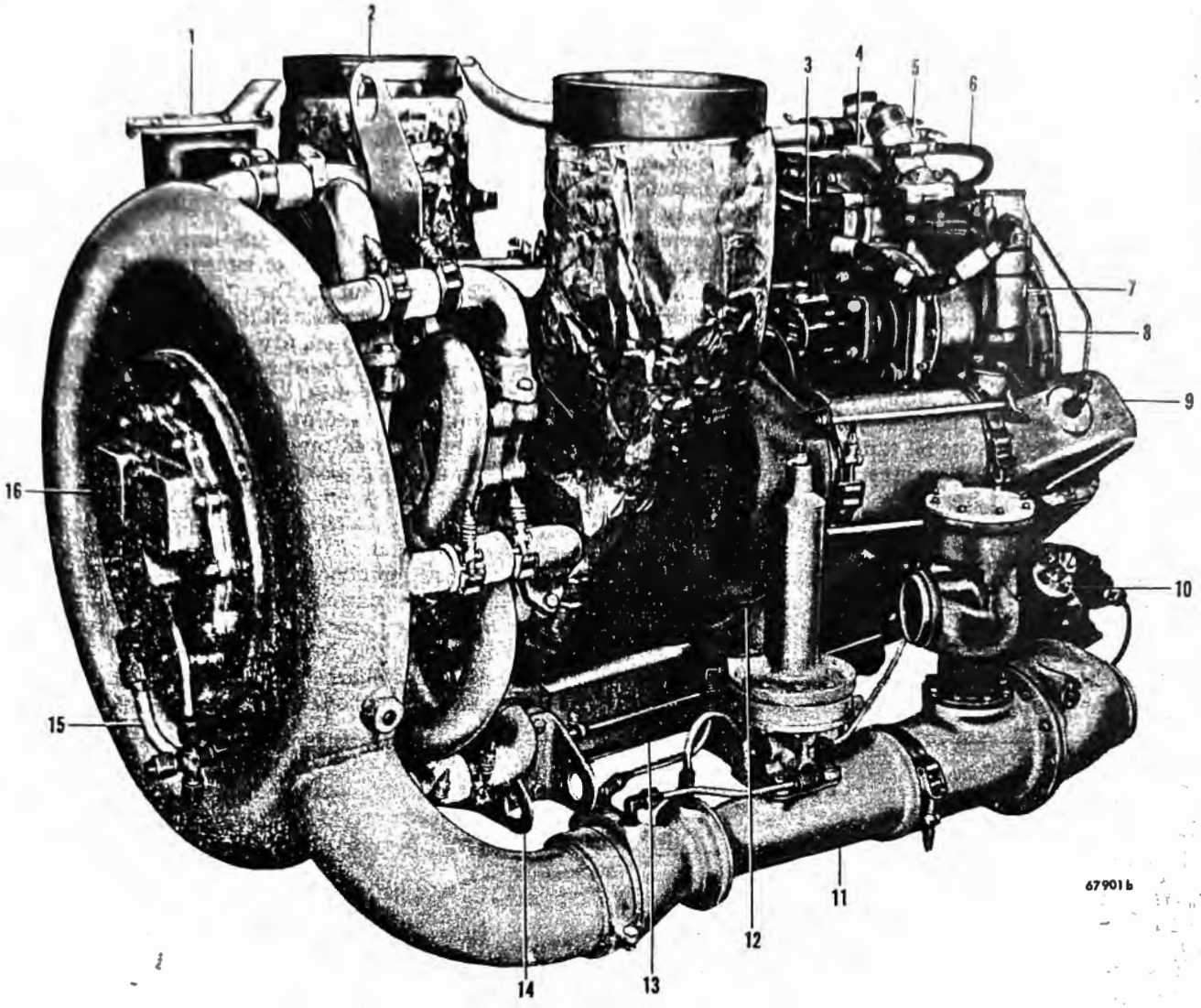
1-5. DESCRIPTION OF ENGINE.

1-6. SUMP AND BASE SECTION. (See figure 4-13.) The sump and base section consists of the oil sump and base assembly, two heat shields, an oil strainer, a dipstick, an oil manifold bracket, and an air flow control assembly bracket. The oil sump and base assembly casting contains a one gallon capacity oil reservoir and supports the rotor section. Four studs that extend horizontally from the rear of the casting connect the oil sump and base assembly to the two-stage compressor assembly.



1. GAS PRODUCER SECTION
2. ENGINE FUEL SYSTEM
3. ACCESSORY DRIVE ASSEMBLY
4. ACCELERATION LIMITER
5. STARTER-GENERATOR
6. FUEL PUMP AND GOVERNOR ASSEMBLY
7. ROTOR SECTION
8. EXHAUST COLLECTOR ASSEMBLY
9. OIL SEPARATOR ASSEMBLY
10. ENGINE LUBRICATION SYSTEM
11. TWO-STAGE COMPRESSOR ASSEMBLY
12. SUMP AND BASE SECTION
13. NOZZLE RING
14. BURNER SECTION
15. LUBE AND SCAVENGE PUMP
16. IGNITER COIL ASSEMBLY

FIGURE 1-1. GAS TURBINE ENGINE, MODEL 502-7D (Sheet 1 of 2)

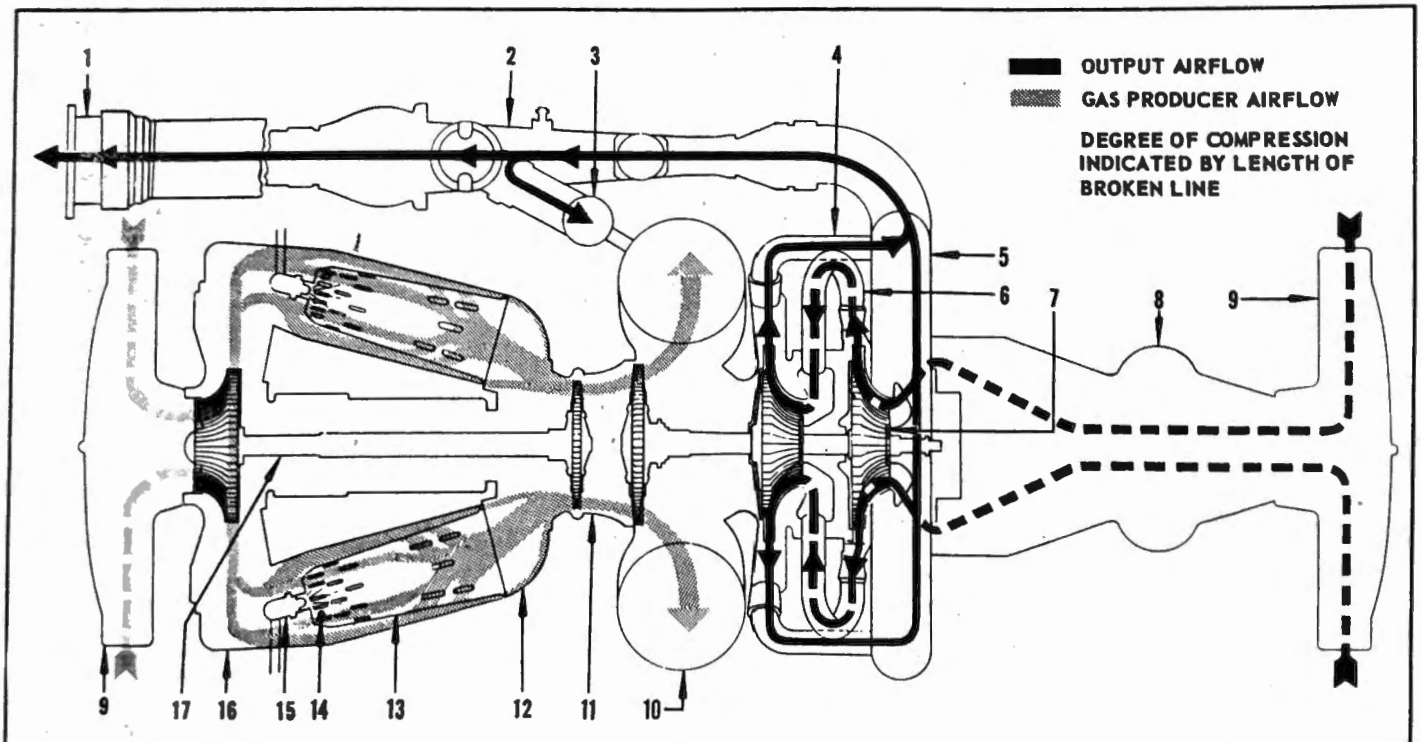


1. OIL SEPARATOR ASSEMBLY
2. EXHAUST COLLECTOR ASSEMBLY
3. FUEL PUMP AND GOVERNOR ASSEMBLY
4. ACCESSORY DRIVE ASSEMBLY
5. FUEL SOLENOID
6. ENGINE FUEL SYSTEM
7. HIGH PRESSURE FUEL FILTER
8. GAS PRODUCER SECTION
9. BURNER SECTION
10. OIL PRESSURE SWITCH
11. AIR FLOW CONTROL ASSEMBLY
12. NOZZLE BOX
13. SUMP AND BASE SECTION
14. ENGINE MOUNTING BRACKET
15. ENGINE LUBRICATION SYSTEM
16. TWO-STAGE COMPRESSOR ASSEMBLY

FIGURE 1-1. GAS TURBINE ENGINE, MODEL 502-7D (Sheet 2 of 2)

1-7. ROTOR SECTION. (See figure 4-10.) The rotor section, includes the balancing assembly and the housings that enclose and support it. The balancing assembly consists of a turbine wheel and shaft assembly, which is a welded assembly, and an impeller that is keyed to the shaft, a pinion gear keyed to the shaft, an oil slinger, a ball bearing and two nuts. This assembly is factory-balanced as a unit, and individual components must not be replaced without subsequent rebalancing of the complete assembly. The balancing assembly is supported on three bearings in the rotor housing. The ball bearing of the balancing assembly is at the compressor end and serves to absorb thrust. A floating bearing near the center of the shaft, and a floating bushing at the turbine wheel end are both full-floating sleeve bearings. The steady bearing is aluminum and the turbine bearing is lead-bronze. The ball bearing is lubricated by spray from an oil jet that is screwed into the rotor housing; and drilled passages in the rotor housing conduct oil under pressure to the two floating bearings. The turbine bearing cap receives air that is bled from the compressor casing assembly. The air is directed against the turbine wheel hub for cooling, and through the air and oil seals to prevent hot gas from entering or oil being forced out of the rotor housing. The compressor casing assembly, which is a two-piece aluminum housing that encloses the balancing assembly impeller, is bolted to the front of the rotor housing. The front and rear halves of the compressor casing assembly are machined as matched sets and must be replaced as an assembly. The nozzle box assembly, which is bolted to a flange near the rear of the rotor housing and encloses the upstream (forward) side of the turbine wheel, is a welded stainless steel shroud containing a ring of fixed vanes. Accessories and aluminum housings near the nozzle box assembly are protected from radiated heat by stainless steel heat shields below and forward of the nozzle box assembly, and an insulating ring assembly between the rotor housing and the nozzle box assembly.

1-8. BURNER SECTION. (See figure 4-9.) The burner section is composed of two burners and an interconnecting crossfire tube. The two burners are made up of the same components with the exception of the burner liner assemblies, which are designated right and left. Each burner consists of a burner elbow assembly, burner liner assembly, burner shell assembly, and connecting parts and seals. The fuel nozzle (with adapter) is screwed into a boss in the burner elbow assembly, and the vapor spark plug assembly is bolted to a boss at the bottom of the burner elbow assembly. The burner liner assembly is positioned within the burner by means of the fuel nozzle adapter, vapor spark plug assembly, and a liner support ring which is welded in the downstream end of the burner shell assembly. The crossfire tube assembly is threaded to each burner shell assembly, and a sleeve and nipple connect it to each burner liner assembly. Each burner elbow assembly is bolted to an outlet port of the com-



1. COMPRESSED AIR OUTLET
2. AIR FLOW CONTROL ASSEMBLY
3. BYPASS AIR OUTLET
4. SECOND STAGE TUBE ASSEMBLY
5. AIR COLLECTOR ASSEMBLY
6. FIRST-STAGE TUBE ASSEMBLY
7. ROTOR ASSEMBLY
8. OIL COOLER ASSEMBLY
9. INLET SILENCER ASSEMBLY
10. EXHAUST COLLECTOR ASSEMBLY
11. NOZZLE RING ASSEMBLY
12. NOZZLE BOX ASSEMBLY
13. BURNER LINER ASSEMBLY
14. VAPOR SPARK PLUG ASSEMBLY
15. FUEL NOZZLE ASSEMBLY
16. BURNER ELBOW ASSEMBLY
17. BALANCING ASSEMBLY

FIGURE 1-2. AIR FLOW DIAGRAM

pressor casing assembly. The downstream end of each burner shell assembly is clamped to an inlet port of the nozzle box assembly. Two tie bolts secure each burner assembly between the burner elbow assembly and the nozzle box assembly.

1-9. ACCESSORY DRIVE ASSEMBLY. (See figure 4-8.) The accessory drive assembly is mounted on the top of the rotor housing and contains a gear system that drives a fuel pump and governor assembly, a tachometer generator, a starter-generator, and a lubrication and scavenge pump. The accessory drive gears are driven by the pinion which is part of the balancing assembly. The fuel pump and governor assembly and tachometer generator are mounted on drive pads on the rear of the accessory drive housing. The starter-generator, which has its own drive gear which meshes with accessory drive gearing, is bolted to the rear of the accessory drive housing. The lubrication and scavenge pump is mounted on the bottom of the rotor housing and is driven through a drive shaft by a helical gear in the accessory drive assembly. The gears and bearings of the accessory drive assembly are lubricated by spray from a lube jet nozzle.

1-10. AIR INLET SILENCER ASSEMBLY. (See figure 4-25.) The high frequency sound level of inlet air passing over the impeller is reduced to approximately 80 decibels at rated speed by an inlet silencer assembly that is attached with a clamp to the inlet of the compressor casing assembly. As shown in figure 4-25, the inlet silencer assembly consists of a bell-shaped duct and a convex cover that are separated by spacers and lined with fiberglas. An identical silencer is installed in the power package at the rear of the engine assembly.

1-11. NOZZLE RING ASSEMBLY. (See figure 4-2.) The nozzle ring assembly is a welded stainless steel duct that contains a ring of fixed vanes. As shown in figure 4-2, the nozzle ring assembly is attached by a clamp to the outlet of the nozzle box assembly; its outlet end fits inside the exhaust collector inlet and serves as a gas seal and expansion joint between the gas producer section and two-stage compressor assembly. Insulating blankets surround the nozzle ring assembly to reduce the amount of heat radiation.

1-12. EXHAUST COLLECTOR ASSEMBLY. (See figure 4-2.) Two exhaust collector shell assemblies (right and left) are bolted together to form the exhaust collector assembly. A ridge in the rear opening of the exhaust collector assembly mates with a groove in the periphery of the inner cone of the two-stage compressor assembly to secure the exhaust collector assembly to the compressor. Each shell assembly is enclosed in an insulating blanket.

1-13. ROTOR ASSEMBLY. (See figure 4-6.) The two-stage compressor rotor assembly consists of the turbine wheel and shaft assembly, ball bearing, oil slinger, impeller, interstage spacer, first-stage impeller, oil slinger, roller bearing, retainer nut, locking slug and set screw. The turbine wheel is shrunk onto the shaft; the impellers are splined to the shaft. This assembly is factory-balanced as a unit, and individual components must not be replaced without subsequent rebalancing of the complete assembly.

1-14. TWO-STAGE COMPRESSOR HOUSING ASSEMBLY. (See figure 4-6.) The two-stage compressor housing assembly is built up of three housings that are machined as a matched set. The first-stage housing bolts to the interstage housing to form an enclosure and diffuser for the first-stage impeller; the second-stage housing bolts to the interstage housing to form an enclosure and diffuser for the second-stage impeller. The inner cone assembly, which deflects the gas leaving the rotor assembly turbine wheel into the exhaust collector, is bolted to the second-stage housing. An unused accessory drive housing is located at the rear of the first-stage housing. The compressor housing assembly supports the rotor assembly on three bearings: a lead-bronze floating sleeve bearing at the turbine wheel, a ball bearing at the second-stage impeller that absorbs the thrust of the rotor assembly, and a roller bearing at the first-stage impeller. Lubricating oil enters the rotor assembly through a boss in the accessory drive cover at the compressor air inlet. An oil jet mounted in this cover sprays the roller bearing, and drilled passages in the cover conduct the oil to the rotor shaft, which is hollow. The ball bearing and the floating bearing are lubricated through holes drilled in the hollow center of the rotor shaft. Air bled from the second-stage compressor impeller aids the second-stage oil slinger in preventing oil loss into the impeller housing. Air is also routed to the turbine bearing cap which directs it against the turbine wheel hub for cooling and into the compressor housing to prevent oil loss at the floating bearing. Air bled from the first-stage compressor impeller through drilled passages in the housing aids the first-stage oil slinger in preventing oil loss at the roller bearing. An air seal prevents air leakage from the second-stage to the first-stage compressor. Eight first-stage tube assemblies conduct compressed air from the first-stage compressor outlets to the inlet of the second-stage compressor, and eight second-stage tubes conduct compressed air to the air collector assembly which is supported by hoses clamped to the second-stage tubes. The lower portion of the second-stage housing forms the base of the output compressor, which is bolted to the oil sump and base assembly. The base contains an oil scavenge sump where oil is collected after lubricating the rotor assembly bearings.

1-15. AIR FLOW CONTROL ASSEMBLY. (See figure 4-5.) The air flow control assembly, which is connected to the discharge tube of the air collector assembly, is made up of a venturi tube, a pressure ratio sensing unit, a pneumatically actuated bypass valve, and connecting tubing. The pressure ratio sensing unit receives air pressure from taps at the throat of the venturi tube and, on the basis of pressure ratio between these points, regulates air pressure to the bypass valve to control the amount of air bypassed to atmosphere. The air flow control assembly thus provides for maximum output from the compressor without surge. A flapper type check valve at the downstream end of the air flow control assembly serves to prevent back flow of air whenever the discharge duct is connected to a source of higher pressure.

1. Clamp
2. Exhaust collector assembly
3. Nozzle ring assembly
4. Air collector assembly
5. Second stage tube assembly
6. First stage tube assembly
7. Accessory drive assembly
8. Compressor forward casing
9. Cotter pin
10. Impeller fairing nut
11. Impeller nut
12. Impeller washer
13. Impeller assembly
14. Impeller key
15. Bearing cap assembly
16. Oil slinger
17. Retainer plate
18. Wheel and shaft assembly
19. Woodruff key
20. Pinion
21. Ball bearing
22. Bearing retainer
23. Air deflector
24. Insulating ring assembly
25. Bearing cap and oil seal assembly
26. Gasket
27. Retainer plate
28. Floating bearing
29. Bearing retainer
30. Retainer plate
31. Floating bushing
32. Bearing retainer
33. Nozzle box assembly
34. Heat shield
35. Compressor rear casing
36. Rotor housing
37. Oil sump and base assembly
38. Nozzle box drain

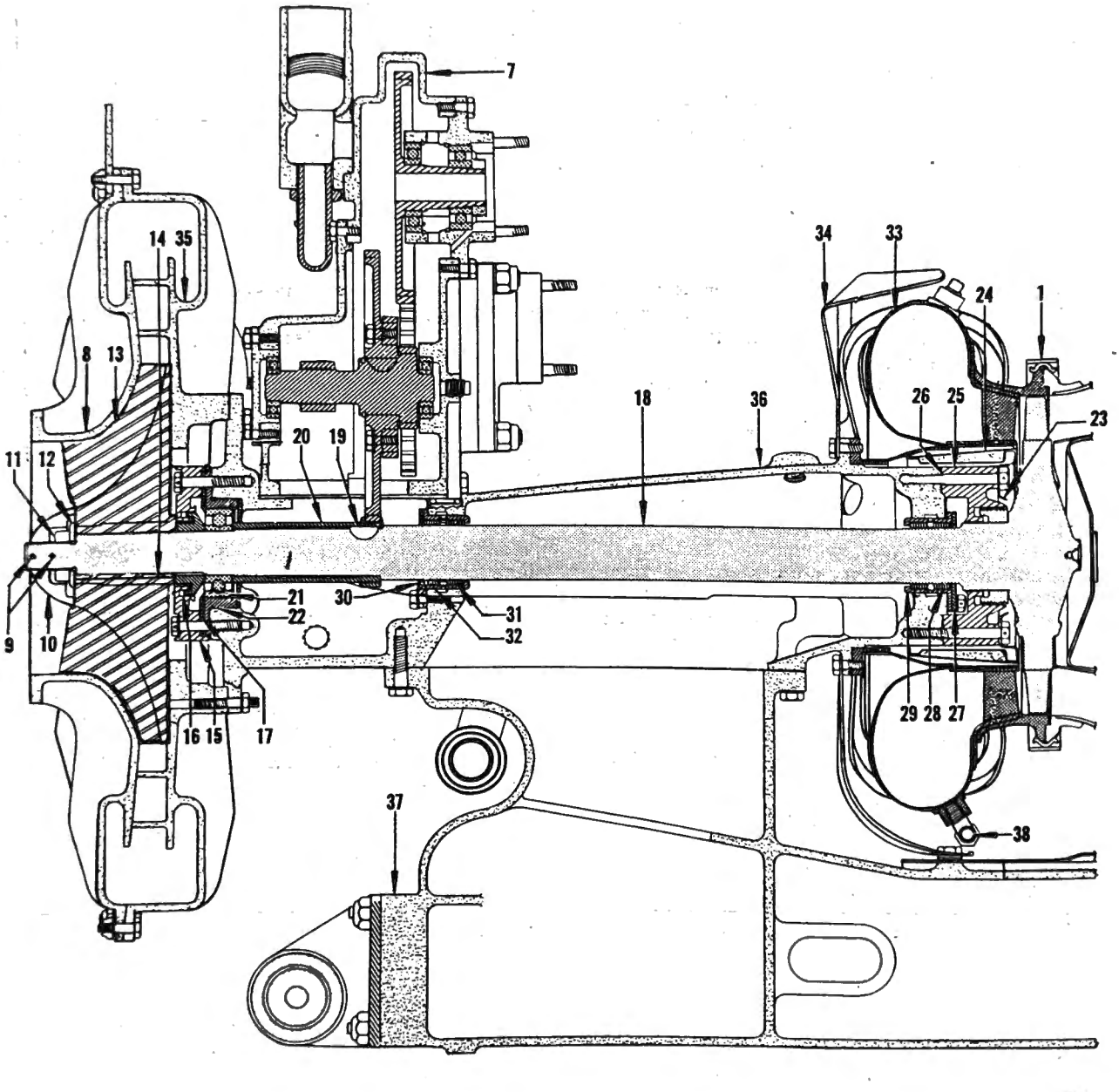


FIGURE 1-3. ENGINE ASSEMBLY - CUTAWAY VIEW (Sheet 1 of 2)

39. Accessory drive cover
40. Adapter
41. Set screw
42. Locking slug
43. Nut
44. Lock ring
45. First stage housing
46. Roller bearing
47. Oil slinger
48. First stage impeller assembly
49. Bearing retainer
50. Interstage housing
51. Spacer
52. Air seal
53. Second stage impeller assembly
54. Spacer
55. Bearing cap assembly
56. Oil slinger
57. Retainer plate
58. Ball bearing
59. Bearing retainer
60. Wheel and shaft assembly
61. Bearing cap assembly
62. Retainer plate
63. Floating bearing
64. Bearing retainer
65. Inner cone assembly
66. Second stage housing

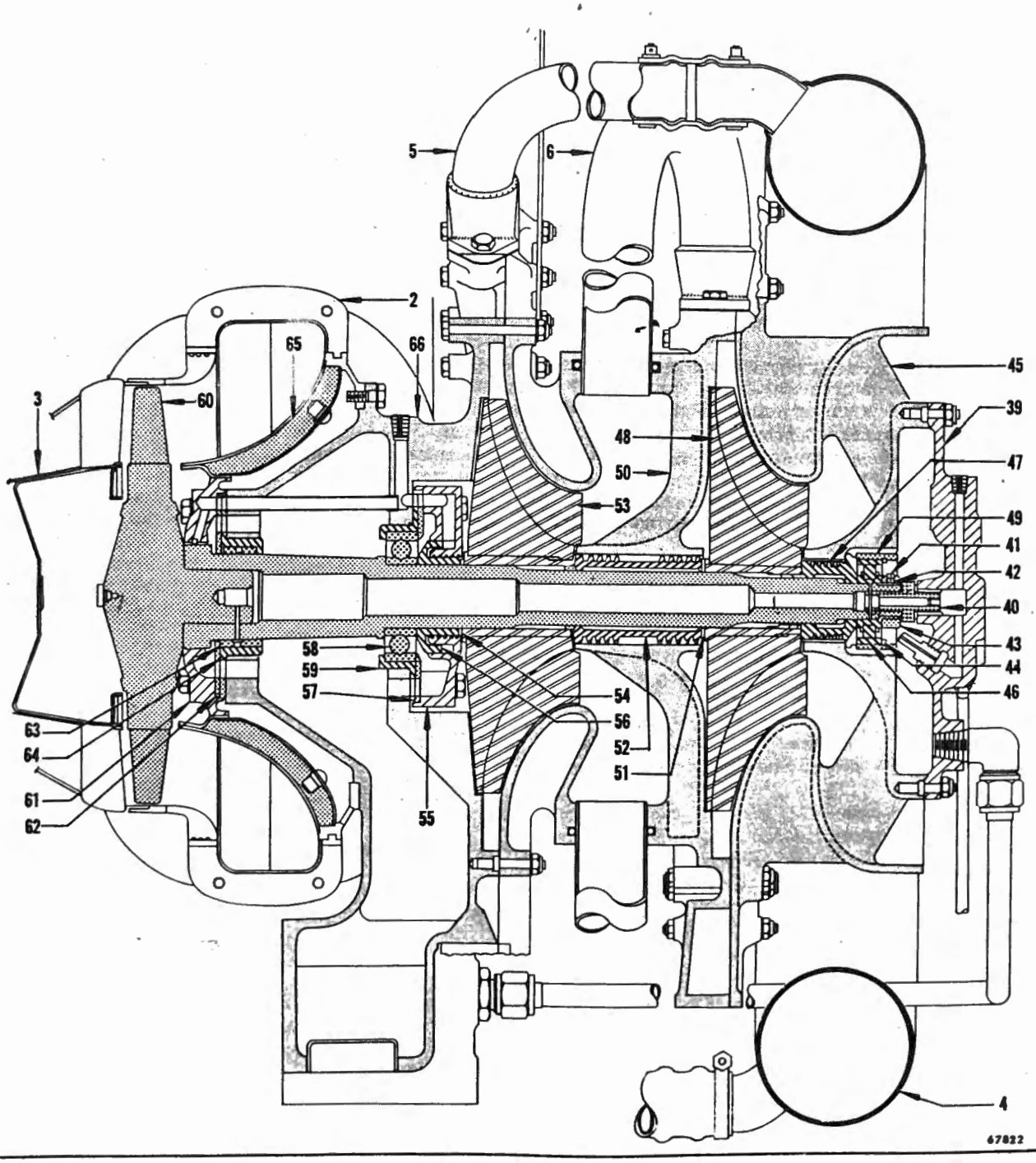


FIGURE 1-3. ENGINE ASSEMBLY - CUTAWAY VIEW (Sheet 2 of 2)

1-16. FUEL SYSTEM. (See figure 4-3.) The components and lines which make up the engine fuel system are mounted on the gas producer section of the engine. In service, fuel is supplied to fuel system at the inlet port of the pump by the fuel system installation of the power set assembly. The engine fuel system consists of a fuel pump and governor assembly, a high pressure fuel filter, a fuel solenoid, two fuel nozzle assemblies, an acceleration limiter, a pressure relief valve, and connecting tubing. During operation fuel flows in the following manner:

a. Fuel is drawn into the engine fuel system at the inlet port of the fuel pump assembly and is directed under pressure to the high pressure fuel filter. The fuel pump is a gear type pump driven by the accessory drive assembly. The high pressure fuel filter is a replaceable element type filter.

b. Fuel leaving the high pressure fuel filter enters the governor portion of the fuel pump and governor assembly. The governor meters the flow of fuel, bypassing excess fuel to the inlet port of the fuel pump through internal passages.

c. Fuel from the governor flows to the fuel solenoid, which is a solenoid actuated disc valve. A bypass line from a tee at the inlet to the fuel solenoid connects to the acceleration limiter.

d. When the fuel solenoid is open, fuel flows to the two fuel nozzle assemblies where it is sprayed into the burners.

e. The acceleration limiter balances fuel nozzle pressure against compressor discharge pressure by bypassing excess fuel during starting and rapid acceleration to keep nozzle box temperature within safe limits. Bypassed fuel is returned to the inlet port of the fuel pump assembly through a 40 psi pressure relief valve. Air is bled from the compressor casing to the acceleration limiter. A drain port is provided that connects to power package tubing.

1-17. ENGINE LUBRICATION SYSTEM. (See figures 4-4 and 6-6.) The engine lubrication system includes a lube and scavenge pump, a drive shaft, an oil manifold, an oil separator, an oil breather body, two strainers, an oil separator, an oil breather body, two strainers, and connecting tubing. The lube and scavenge pump, which is a two section vane type pump driven by the accessory drive assembly, draws oil from the supply reservoir in the oil sump and base assembly through a strainer screen. Oil leaving the pump is directed through an oil filter to the two-stage compressor assembly and the oil manifold. Oil is distributed from the oil manifold to an oil pressure switch, the accessory drive assembly, and the rotor housing. Oil from the scavenge sump in the output compressor housing is drawn through a strainer by the scavenge section of the lube and scavenge pump and is directed to a port in the rotor housing, from where it returns by gravity to the supply reservoir. In service, the scavenged oil is cooled by passing through an oil cooler before entering the rotor housing. Compressor and rotor housing case pressure is relieved through the oil separator, which condenses oil vapor and returns it to the supply reservoir. Case pressure in the accessory drive assembly is relieved through the oil breather body, which also serves as an oil filler.

1-18. ELECTRICAL SYSTEM. The engine electrical system includes a starter-generator, starter relay, voltage regulator, fuel solenoid, two ignition boost coils, two vapor spark plugs, an oil pressure switch, a tachometer generator, tachometer indicator, an air temperature thermocouple, four exhaust temperature thermocouples, an exhaust temperature gage, and connecting wiring. Additional connecting wiring, relays, switches and gages that complete the power package electrical system are installed on the power package. The starter-generator is a 24V dc motor that serves as generator when the engine is operating. The vapor spark plug assemblies are combination glow coil and spark units. The ignition boost coils supply high voltage to the spark electrodes of the vapor spark plug, while the glow coil operates on 24V dc. The exhaust temperature gage is a combination pyrometer and overtemperature switch.

SECTION II

TABLE OF SPECIFICATIONS

2-1. GENERAL.

2-2. A list of specifications required for overhaul of the gas turbine engine assembly, model 502-7D, and accessories is given in Table I.

TABLE I. SPECIFICATIONS

1. ENGINE	
Model	Model 502-7D
Make	Boeing
Type	Continuous combustion, compressed air output
Weight (without accessories)	314 lb
Weight (with attached accessories)	336 lb
Compressed air output (at 36,500 rpm gas producer speed)	1.52 lb/sec at 52.8 psig and 412°F
Gas Producer Compressor	
Type	Single stage, single entry, centrifugal
Compression ratio (at 36,500 rpm gas producer speed)	3 to 1
Air flow (at 36,500 rpm gas producer speed)	3.5 lb/sec
Fuel flow (at 36,500 rpm gas producer speed)	240 lb/hr
Balancing Assembly	
Number of bearings	Two: one ball, one floating
Number of bushings	One: floating
Rated speed (maximum)	36,500 rpm
Rotation (as viewed from rear of engine)	Counterclockwise
Impeller diameter	8.505 inch
Turbine, type	Single stage, axial flow
Turbine wheel diameter	7.055 inch
Output Compressor, type	Two stage, single entry, centrifugal
Output Compressor, rotor assembly	
Number of bearings	Three: one ball, one roller, one floating
Rated speed (at 36,500 rpm gas producer speed)	27,000 rpm
Rotation (as viewed from rear of engine)	Counterclockwise
First-stage impeller diameter	9.200 inch
Second-stage impeller diameter	8.505 inch
Turbine, type	Single stage, axial flow
Turbine wheel diameter	9.008 inch
Burners, type	Through flow
Burners, number	Two
Exhaust Collector, type	Dual outlet
Method of Suspension	Three point, rubber shock mounted
Air Flow Control Assembly	
Make	Boeing
Manufacturer's part No.	5-91172
Type	Pneumatic
2. FUEL SYSTEM	
Fuel Pump and Governor Assembly	
Make	Woodward
Manufacturer's part No.	400810C
Rotation (as viewed from rear of engine)	Clockwise

TABLE I. SPECIFICATIONS (Continued)

2. FUEL SYSTEM (Continued)

Speed ratio to balancing assembly	1 to 12
Pump, make	Woodward
Manufacturer's part No.	400496
Type	Gear
Pump, inlet port size	.375 inch diameter
Governor, type	Flyweight
Acceleration Limiter	
Make	Woodward
Manufacturer's part No.	400830
Type	Pneumatic
Fuel Nozzle Assemblies	
Make	Boeing
Manufacturer's part No.	3-91099-1
Rating	10.5 gal/hr at 100 psi
Operating pressure	30 to 450 psi
Number used	Two
High Pressure Fuel Filter	
Type	Replaceable element
Part No.	AN6234-3
Element part No.	AN6235-3A
Low Pressure Fuel Filter	
Type	Strainer
Make	Purolator
Manufacturer's part No.	27314
Fuel	MIL-F-5624A (Grade JP-4)
Fuel, emergency (maximum exhaust temperature 1100°F)	MIL-G-3056 or MIL-F-5572

3. OIL SYSTEM

Lube and Scavenge Pump	
Make	Romec
Manufacturer's part No.	RD7150A, RD7150C
Type	Vane
Rotation (as viewed from bottom of engine)	Clockwise
Speed ratio to balancing assembly	1 to 8.36
Lube Filter	
Type	Replaceable element
Make	Purolator
Manufacturer's part No.	35548
Element part No.	34752
Operating Pressure	Idle: 20 psi Rated speed: 35-80 psi
Operating Oil Temperature (entering cooler)	275°F Maximum
Oil Recommended, normal	MIL-O-2104 (SAE 10)
Oil Recommended, -18°C (0°F) to -29°C (-20°F)	MIL-O-6081A (Grade 1010)
Oil Recommended, below -29°C (-20°F)	MIL-O-6081A (Grade 1005)
Oil Sump Capacity	4 quarts

4. ELECTRICAL SYSTEM

Type	24V dc, negative ground
Starter-Generator	
Manufacturer and part No.	Boeing 9-91343, Boeing 6-91036, EEMCO D546NR
Rotation (as viewed from rear of engine)	Counterclockwise
Speed ratio to balancing assembly	1 to 3.58
Motor, volts, dc	24
Motor, amperes	135 with 70 lb in. torque load
Motor, speed	1,650 rpm with 70 lb in. torque load

TABLE I. SPECIFICATIONS (Continued)

4. ELECTRICAL SYSTEM (Continued)

Generator, volts, dc	27 at 6,000 rpm		
Generator, amperes	30 at 6,000 rpm		
Weight	15.75 lb		
Voltage Regulator			
Make	Boeing Airplane Co. (Altered from Electric Auto-Lite Co. VAO-4001 AM)		
Manufacturer's part No.	9-90597		
Rated voltage	24		
Ground polarity	Negative		
Current regulator air gap	.047 - .049 inch		
Current regulator setting	30.0 - 32.0 amp		
Relay air gap	.060 - .065 inch		
Relay point opening	.025 inch min		
Relay, points open at	3.0 - 5.0 amp		
Relay, points close at	26.0 - 27.2 volts		
Voltage regulator air gap	.040 - .042 inch		
Voltage regulator setting (at 70°F)	29.3 volts		
Igniter Coil Assembly			
Make	Eclipse-Pioneer		
Manufacturer's part No.	1367-10A		
Quantity per engine	Two		
Current draw	1.0 to 1.2 amp at 24V		
Vapor Spark Plug Assembly			
Type	Glow coil igniter		
Quantity per engine	Two		
Make	Boeing		
Manufacturer's part No.	6-91398,	9-90734,	9-90025-1,
Electrode gap	.080 - .100 inch	.080 - .100 inch	.080 - .100 inch
Glow coil voltage	22.0 - 24.0 volts	20.0 - 24.0 volts	20.0 - 24.0 volts
Glow coil current	12.0 - 30.0 amp	9.0 - 15.0 amp	9.0 - 15.0 amp
Starter Relay Part No.	AN3372-2		
Oil Pressure Switch			
Make	Nason		
Manufacturer's part No.	Model A		
Cutout setting	18 - 20 psi		
Air Temperature Thermocouple			
Type	Iron-constantan		
Make	Lewis		
Manufacturer's part No.	8T31B198		
Number used	One		
Exhaust Thermocouple			
Type	Chromel-alumel		
Make	Boeing		
Manufacturer's part No.	9-91266		
Quantity per engine	Four		
Exhaust Temperature Indicating Circuit Wiring	Chromel-alumel		
Exhaust Temperature Pyrometer			
Type	Indicator and overtemperature switch		
Make	Assembly Products		
Manufacturer's part No.	A1479 (Optional A5292)		
External circuit resistance	7.90 - 8.10 ohms		
Overtemperature switch setting	654.4°C (1210°F)		
Tachometer Generator			
Type	Electric		
Part number	AN5544-3		
Rotation (as viewed from rear of engine)	Clockwise		
Speed ratio to balancing assembly	1 to 10		
Tachometer Indicator			
Make	General Electric		
Manufacturer's part No.	8DJ43BAH-14, 8DJ43BAH-12		

TABLE I. SPECIFICATIONS (Continued)

4. ELECTRICAL SYSTEM (Continued)

Fuel Solenoid

Make	General Controls
Manufacturer's part No.	AV-1B-1202
Voltage	24
Watts	18
Pressure, maximum	300 psi
Normal position, de-energized	Closed

SECTION III
SPECIAL TOOLS

3-1. FUNCTIONAL TOOL LIST.

3-2. Special tools required for overhaul of the gas turbine engine assembly, model 502-7D, are listed according to function in Table II.

TABLE II. FUNCTIONAL TOOL LIST

GROUP NO.	FUNCTION Tool nomenclature	TOOL NUMBER	FIGURE NUMBER	NOTES
1.	ACCESSORY DRIVE ASSEMBLY REMOVING AND INSTALLING			
	Accessory drive wrench	9BBQ-F50219	8-1	
2.	BALL BEARING INSTALLING			
	Compressor bearing installation press	9BBQ-F50212	7-4	
3.	FAIRING NUT REMOVING AND INSTALLING			
	Impeller fairing nut wrench	9BBQ-F50202	7-6	
4.	FUEL NOZZLE ASSEMBLY DEPTH CHECKING			
	Fuel nozzle depth checking gage	9BBQ-F50216	7-1	
	FUEL NOZZLE ASSEMBLY PRESSURE CHECKING			
	Fuel nozzle pressure test clamp assembly	9BBQ-F50215	7-2	
5.	IMPELLER ASSEMBLY HOLDING			
	Impeller spanner wrench assembly	9BBQ-F50203	7-5	
	IMPELLER ASSEMBLY REMOVING			
	Impeller puller cap	9BBQ-F50205	4-11	
6.	TACHOMETER GENERATOR DRIVE REMOVING AND INSTALLING			
	1/2 square drive spare pad drive lock nut spanner wrench	9BBQ-F50209	7-3	
7.	FUEL PUMP AND GOVERNOR ASSEMBLY DRIVE REMOVING AND INSTALLING			
	1/2 square drive fuel pump drive lock nut spanner wrench	9BBQ-F50208	7-3	
8.	LUBE AND SCAVENGE PUMP REMOVING AND INSTALLING			
	1/2 square drive oil pump drive lock nut spanner wrench	9BBQ-F50207	7-3	
9.	ROTOR ASSEMBLY REMOVING AND INSTALLING			
	Second-stage rotor retainer nut wrench	9BBQ-F50218	7-10	
	ROTOR ASSEMBLY HOLDING			
	Second-stage rotor holder wrench	9BBQ-F50217	7-10	
10.	TURBINE WHEEL AND SHAFT ASSEMBLY REMOVING			
	Compressor bearing removal wedge	9BBQ-F50213	4-12	
	Impeller puller cap	9BBQ-F50205	4-12	
11.	TWO-STAGE COMPRESSOR LOCATING			
	Second-stage heavy hub turbine wheel locating fixture	9BBQ-F50206	8-2	

3-3. NUMERICAL SPECIAL TOOL INDEX.

3-4. Table III is a numerical index of the special tools listed in Table II.

TABLE III. NUMERICAL INDEX FOR SPECIAL TOOLS

TOOL NUMBER	GROUP NUMBER	TOOL NUMBER	GROUP NUMBER
9BBQ-F50202	3	9BBQ-F50212	2
9BBQ-F50203	5	9BBQ-F50213	10
9BBQ-F50205	5, 10	9BBQ-F50215	4
9BBQ-F50206	11	9BBQ-F50216	4
9BBQ-F50207	8	9BBQ-F50217	9
9BBQ-F50208	7	9BBQ-F50218	9
9BBQ-F50209	6	9BBQ-F50219	1

SECTION IV

REMOVAL AND DISASSEMBLY

4-1. GENERAL.

4-2. The instructions contained in this section are provided to enable depot personnel to remove and completely disassemble the major assemblies, subassemblies, accessories and detail component parts of the gas turbine engine assembly, model 502-7D. The removal and disassembly procedures described in this section are arranged in the order of normal accomplishment at the factory or at an overhaul depot. The following outline lists the procedures to be accomplished during removal and disassembly.

4-3. OUTLINE

1. ENGINE ASSEMBLY
   a. Removal from Power Package
      See paragraph 4-6
   b. Removal from Shipping Container
      See paragraph 4-7
   c. Disassembly of Engine Assembly
      See paragraph 4-8 and figures 4-1 and 4-2

2. ENGINE FUEL SYSTEM
   a. Disassembly
      See paragraph 4-11 and figure 4-3

3. ENGINE LUBRICATION SYSTEM
   a. Disassembly
      See paragraph 4-14 and figure 4-4

4. AIR FLOW CONTROL ASSEMBLY
   a. Removal
      See paragraph 4-8 and figure 4-2
   b. Disassembly
      See paragraph 4-18 and figure 4-5

5. TWO-STAGE COMPRESSOR ASSEMBLY
   a. Removal
      See paragraph 4-8 and figure 4-2
   b. Disassembly
      See paragraph 4-22 and figure 4-6

6. GAS PRODUCER SECTION
   a. Disassembly
      See paragraph 4-25 and figure 4-7

7. ACCESSORY DRIVE ASSEMBLY
   a. Removal
      See paragraph 4-25 and figure 4-7
   b. Disassembly
      See paragraph 4-29 and figure 4-8

8. BURNER SECTION
   a. Removal
      See paragraph 4-25 and figure 4-7
   b. Disassembly
      See paragraph 4-33 and figure 4-9

9. ROTOR SECTION
   a. Removal
      See paragraph 4-25 and figure 4-7
   b. Disassembly
      See paragraph 4-37 and figure 4-10

10. SUMP AND BASE SECTION
    a. Removal
       See paragraph 4-25 and figure 4-7
    b. Disassembly
       See paragraph 4-41 and figure 4-13

11. FUEL PUMP AND GOVERNOR ASSEMBLY
    a. Removal
       See paragraph 4-11 and figure 4-3
    b. Disassembly
       See paragraph 4-45 and figure 4-14

12. ACCELERATION LIMITER
    a. Removal
       See paragraph 4-11 and figure 4-3
    b. Disassembly
       See paragraph 4-49 and figure 4-15

13. HIGH PRESSURE FUEL FILTER
    a. Removal
       See paragraph 4-11 and figure 4-3
    b. Disassembly
       See paragraph 4-53 and figure 4-16

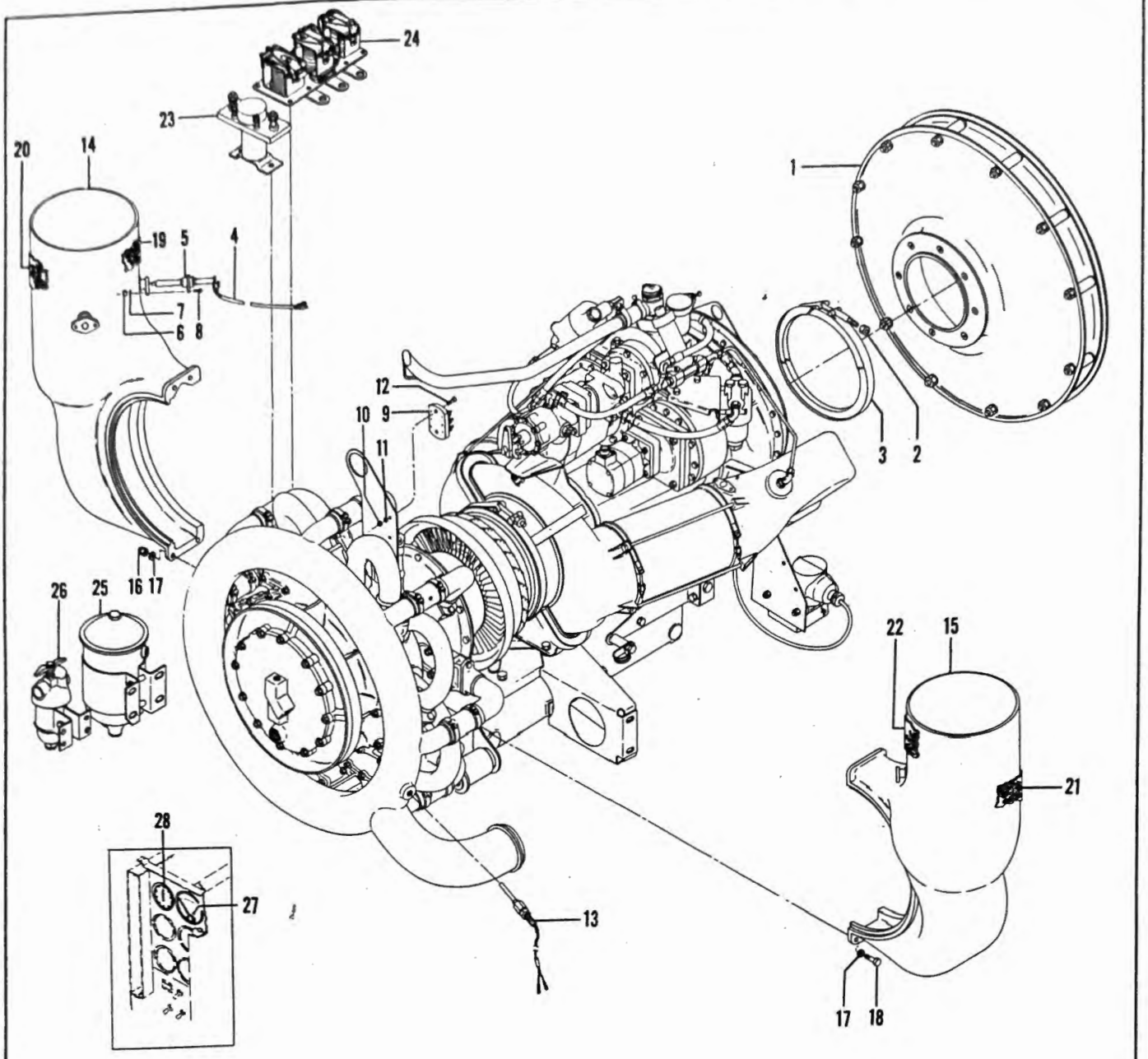
14. FUEL SOLENOID
    a. Removal
       See paragraph 4-11 and figure 4-3
    b. Disassembly
       See paragraph 4-57 and figure 4-17

15. LUBE AND SCAVENGE PUMP
    a. Removal
       See paragraph 4-14 and figure 4-4
    b. Disassembly
       See paragraph 4-16 and figure 4-18

16. OIL PRESSURE SWITCH
    a. Removal
       See paragraph 4-14 and figure 4-4
    b. Disassembly
       See paragraph 4-65 and figure 4-19

17. STARTER-GENERATOR
    a. Removal
       See paragraph 4-25 and figure 4-7
    b. Disassembly
       See paragraph 4-69 and figure 4-20

18. TACHOMETER GENERATOR
    a. Removal
       See paragraph 4-25 and figure 4-7
    b. Disassembly
       See paragraph 4-73 and figure 4-21



1. INLET SILENCER ASSEMBLY
2. NUT
3. CLAMP
4. THERMOCOUPLE WIRE ASSEMBLY
5. THERMOCOUPLE
6. NUT
7. WASHER
8. BOLT
9. JUNCTION BOX
10. NUT
11. WASHER
12. SCREW
13. AIR COLLECTOR THERMOCOUPLE
14. LEFT EXHAUST COLLECTOR SHELL ASSEMBLY
15. RIGHT EXHAUST COLLECTOR SHELL ASSEMBLY
16. NUT
17. WASHER
18. BOLT
19. INSULATION BLANKET
20. INSULATION BLANKET
21. INSULATION BLANKET
22. INSULATION BLANKET
23. STARTER RELAY
24. VOLTAGE REGULATOR
25. LUBE FILTER
26. FUEL FILTER
27. EXHAUST TEMPERATURE PYROMETER
28. ELECTRIC TACHOMETER INDICATOR

FIGURE 4-1. COMPLETE ENGINE ASSEMBLY

19. IGNITER COIL ASSEMBLY
    a. Removal
       See paragraph 4-37 and figure 4-10
    b. Disassembly
       See paragraph 4-77 and figure 4-22

20. LOW PRESSURE FUEL FILTER
    a. Removal
       See paragraph 4-8 and figure 4-1
    b. Disassembly
       See paragraph 4-81 and figure 4-23

21. LUBE FILTER
    a. Removal
       See paragraph 4-8 and figure 4-1
    b. Disassembly
       See paragraph 4-85 and figure 4-24

22. INLET SILENCER ASSEMBLY
    a. Removal
       See paragraph 4-88 and figure 4-1
    b. Disassembly
       See paragraph 4-89 and figure 4-25

23. EXHAUST TEMPERATURE PYROMETER
    a. Removal
       See paragraph 4-8 and figure 4-1
    b. Disassembly
       See paragraph 4-93 and figure 4-26

24. VOLTAGE REGULATOR
    a. Removal
       See paragraph 4-96 and figure 4-1

4-4. ENGINE ASSEMBLY.

4-5. SPECIAL TOOLS. No special tools are required for removal of engine assembly from power package.

4-6. REMOVAL FROM POWER PACKAGE. The engine assembly should be removed from the power package in the following manner:

a. Lift fastener on each side of base frame and air inlet assembly and free fasteners from lugs on removable enclosure assembly. Using handles riveted to sides of removable ecnlosure assembly, lift enclosure assembly clear of power package.

b. Unscrew battery plug on right side of battery and loosen two wing nuts at ends of battery tie rods and lift battery from power package.

c. Unscrew copper oil pressure gage tube assembly from hose assembly which connects to cross fitting located at rear of two-stage compressor assembly.

d. Unscrew hose assembly between oil cooler and scavenge outlet of lube and scavenge pump, from 90° elbow on top of oil cooler.

e. Disconnect hose assembly to outlet port in bottom of lube filter from cross at rear of two-stage compressor.

f. Remove clamp attaching rear transition assembly to inlet silencer assembly.

g. Disconnect air collector thermocouple terminal wires from terminal block on frame adjacent to battery.

h. From two top terminals of junction box on rear hoist fitting disconnect chromel-alumel wires (white and green) that lead to exhaust temperature pyrometer on instrument panel. Remove clamps which attach exhaust thermocouple wires to two-stage compressor assembly. Remove junction box from rear hoist fitting by removing two nuts, two washers and two screws.

i. Remove rod assembly attached to end of governor speed adjusting lever by removing lock nut from stud. Replace lock nut after removing lever.

j. Remove clamp which secures bypass valve exhaust tube to right-hand exhaust collector shell assembly. Remove nut and bolt from connector assembly which secures exhaust tube assembly to air flow control assembly bypass valve. Remove exhaust tube assembly and connector assembly.

k. Disconnect nozzle box drain tube assembly from 90° elbow beneath nozzle box.

l. Disconnect fuel pump drain line from 90° elbow near bottom right side of sump and base assembly.

m. Disconnect acceleration limiter drain hose from nipple in center port on front side of limiter.

n. Disconnect hose assembly from tee fitting at fuel pump inlet on left side of fuel pump. Remove clamp from lower boss on left side of acceleration limiter. Remove two clamps on top of gas producer compressor by removing two nuts. Replace nuts.

o. From bracket on right-hand burner elbow remove two hose clamps by removing fastening screw and lock nut. Pull junction to fuel pump hose assembly and acceleration limiter to junction hose assembly clear of engine.

p. Disconnect oil pressure hose assembly, between pressure outlet of lube and scavenge pump and junction, from inner 90° elbow in junction on frame near oil pressure switch.

q. Disconnect check valve of air flow control assembly from air discharge assembly by removing connector and connector seal.

r. Disconnect scavenge pump to cooler inlet hose assembly from nipple at scavenge outlet of lube and scavenge pump.

s. Disconnect electrical connectors from top of tachometer generator and from fuel solenoid valve. Remove ground wire from tachometer generator and replace nut. Cut lockwire, remove and tag four ground wires from left side of starter-generator. Replace washer and screw.

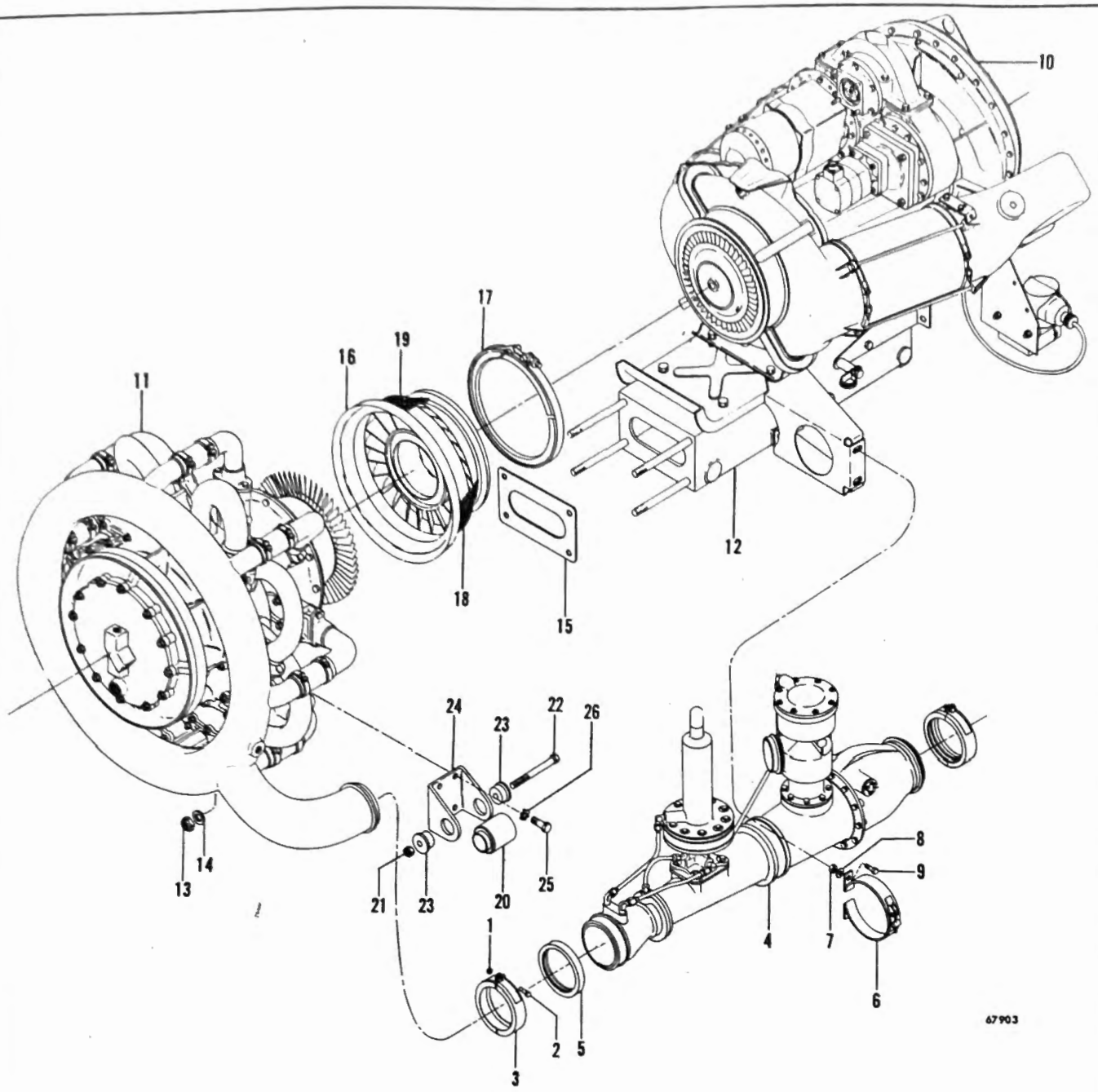
t. Remove upper clamp from left side of acceleration limiter by unscrewing bolt. Remove two double clamps, one from bracket on left-hand burner elbow and other holding wiring and starter-generator cable together just below elbow, by removing two lock nuts and two screws.

u. Remove starter-generator junction box cover by removing two screws. Disconnect at terminals of battery, field and armature wires by removing three lock nuts and washers. Unscrew spanner nut holding conduit to junction box, and pull starter conduit from junction box.

NOTE

To facilitate removal, it is recommended that the junction box be removed from the starter generator after removal of the starter-generator from the accessory drive assembly.

Detach junction box from starter-generator by cutting lockwire and removing two side cover retainers from



1. NUT
2. BOLT
3. CONNECTOR
4. AIR FLOW CONTROL ASSEMBLY
5. SEAL
6. CLAMP
7. NUT
8. WASHER
9. BOLT
10. GAS PRODUCER SECTION
11. TWO-STAGE COMPRESSOR ASSEMBLY
12. SUMP AND BASE SECTION
13. NUT
14. WASHER
15. SHIM
16. NOZZLE RING ASSEMBLY
17. CLAMP
18. INSULATION BLANKET
19. INSULATION BLANKET
20. MOUNT
21. NUT
22. BOLT
23. LORD MOUNT SPACER
24. LORD MOUNT BRACKET
25. BOLT
26. WASHER

FIGURE 4-2. BASIC ENGINE ASSEMBLY

side cover of starter by removing two screws from top and two from bottom of starter terminal base, located between junction box and starter-generator. Replace screws in side cover retainers, side cover and terminal base of starter.

v. Unscrew electrical socket insert connector from pin insert connector in left-hand igniter coil assembly bracket.

w. Disconnect oil sump drain hose assembly from tee fitting on left-hand side of sump and base.

x. Disconnect clamp attaching inlet silencer assembly to gas producer section.

y. Detach front panels of both air inlet compartments by removing ten flat head screws and thirteen round head screws from forward air inlet compartment and thirteen flat head screws and six round head screws from rear air inlet compartment.

z. Attach hoisting sling to front and rear hoist fittings located on top of engine and take strain on sling. Remove three nuts, three bolts and six spacers from engine mount brackets and carefully hoist engine from power package. Replace spacers, bolts and nuts in brackets to prevent losing them.

aa. Disconnect and tag three wires from side (glow coil) terminals on left-hand vapor spark plug assembly and two from right-hand plug assembly be removing two screws, two washers and two lock nuts. Replace screws, washers and nuts. Remove terminal nuts and disconnect and tag three terminal wires to oil pressure switch.

bb. Remove wiring clamp from front of right-hand ignition coil bracket by removing lock nut and bolt. Remove interior coil mounting nuts, washers and bolts, and remove and tag two ground wires from front of left-hand ignition coil bracket and one from front of right-hand ignition coil bracket.

cc. Remove pin insert connector from inside left-hand ignition coil bracket by removing four nuts and four mounting screws.

dd. Remove clamps from rear of left-hand ignition coil bracket and from bottom rear of gas producer compressor by removing two nuts and two bolts. Replace bolt and nut on compressor.

ee. Remove oil cooler transition assembly from two-stage compressor by removing eight bolts and eight washers from perimeter of assembly.

ff. Remove and tag glow coil cable assemblies to both igniter coil assemblies by unscrewing eight filister head screws and washers; detach coil covers and disconnect cables from terminals by removing two nuts and two washers. Unscrew knurled nut and pull glow coil assemblies from case. Replace terminal washers and nuts and reattach covers to coils with eight washers, and filister head screws.

gg. Remove clamp attached to air pressure to gage tube assembly from right-hand igniter lead assembly by removing nut and bolt. Replace nut and bolt to prevent losing them. Remove clamp attached to left-hand ignition coil bracket which attaches left-hand igniter lead assembly.

hh. Pull all detached wiring clear of engine.

4-7. REMOVAL FROM SHIPPING CONTAINER. The engine assembly may be removed from the engine shipping container in the following manner:

a. Remove nuts, bolts and washers which attach cover of shipping container to base.

WARNING

If pressurized metal shipping container is used, air pressure must be relieved at air valve before loosening cover.

b. Lift cover from base. Attach hoisting sling to front and rear fittings and tighten sling to support engine weight.

c. Remove three nuts, three bolts and six spacers from engine mount brackets at front and sides of engine.

d. Carefully hoist engine from shipping container taking care not to damage engine by striking against sides of shipping container.

e. Replace engine mount attaching parts.

f. Place engine on suitable work bench or surface and remove hoisting sling.

4-8. DISASSEMBLY. (See figures 4-1 and 4-2.) The engine assembly should be disassembled in the following manner:

a. (See figure 4-1.) If installed, detach inlet silencer assembly (1) from gas-producer compressor by removing fastening nut (2) and clamp (3).

b. (See figure 4-1.) Remove eight wire terminals from exhaust collector thermocouples by removing eight nuts from thermocouple terminal posts. Replace nuts after wire terminals are removed. Remove eight thermocouple wire terminals (4) from lower four junction box terminals by removing four nuts from terminal posts. Replace nuts after removal of wire terminals.

c. (See figure 4-1.) Carefully remove four thermocouples (5) by removing two lock nuts (6), two washers (7) and two bolts (8).

d. (See figure 4-1.) Remove junction box (9) from rear hoist fitting by removing two nuts (10), two washers (11) and two screws (12).

e. (See figure 4-1.) Disconnect terminal wires of air collector thermocouple from terminal block next to battery in cubicle by removing two nuts and two washers Replace nuts and washers after removal of wires. Unscrew air collector thermocouple (13) from right side of compressor air collector.

f. (See figure 4-2.) The air flow control assembly should be removed in the following manner:

1. Remove two nuts (1), two bolts (2) and detach two connectors (3). Open Marman clamp by removing fastening nut on clamp and carefully remove air flow control assembly (4). Pull seals (5) from ends of air flow control assembly. Remove clamp (6) by removing two nuts (7), two washers (8) and two bolts (9).

g. (See figure 4-2.) Remove engine fuel system from gas producer section (10) in accordance with instructions in paragraph 4-11.

h. (See figure 4-2.) Remove engine lubrication system (11) from gas producer and two-stage compressor assembly (11) in accordance with instructions in paragraph 4-14.

i. (See figure 4-1.) Separate and remove the two exhaust collector shell assemblies (14) and (15) by removing four nuts (16), eight washers (17) and four bolts (18). Remove wire and insulation blankets (19) and (20) from left exhaust collector shell assembly and remove insulation blankets (21) and (22) from right exhaust collector shell assembly.

KEY TO FIGURE 4-3.

1. TUBE ASSEMBLY
2. TEE
3. NUT
4. O-RING
5. RELIEF VALVE
6. O-RING
7. CLAMP
8. HOSE ASSEMBLY
9. ELBOW
10. NUT
11. O-RING
12. 90° ELBOW
13. NUT
14. O-RING
15. HOSE ASSEMBLY
16. ELBOW
17. NUT
18. O-RING
19. ELBOW
20. NUT
21. O-RING
22. UNION
23. O-RING
24. ACCELERATION LIMITER
25. NUT
26. WASHER
27. SPACER
28. BOLT
29. ACCELERATION LIMITER BRACKET
30. BOLT
31. BOLT
32. SPACER
33. WASHER
34. WASHER
35. NUT
36. SCREW
37. CLAMP
38. CLAMP
39. HOSE ASSEMBLY
40. ELBOW
41. NUT
42. O-RING
43. TUBE ASSEMBLY
44. ELBOW
45. NUT
46. O-RING
47. TEE
48. NUT
49. O-RING
50. CLAMP
51. ELBOW
53. NUT
54. O-RING
55. ELBOW
56. NUT
57. O-RING
58. HOSE ASSEMBLY
59. ELBOW
60. NUT
61. O-RING
62. TEE
63. NUT
64. O-RING
65. HOSE ASSEMBLY
66. UNION
67. O-RING
68. ELBOW
69. NUT
70. O-RING
71. BUSHING
72. O-RING
73. FUEL PUMP AND GOVERNOR ASSEMBLY
74. NUT
75. WASHER
76. GASKET
77. TUBE ASSEMBLY
78. ELBOW
79. NUT
80. O-RING
81. HIGH PRESSURE FUEL FILTER
82. BOLT
83. SPACER
84. FUEL SOLENOID
85. NUT
86. WASHER
87. SPACER
88. SPACER
89. BOLT
90. BRACKET
91. BOLT
92. WASHER
93. WASHER

FIGURE 4-3. ENGINE FUEL SYSTEM (Sheet 1 of 2)

j. (See figure 4-2.) Remove two-stage compressor assembly from sump and base section (12) and nozzle ring in following manner:

1. From studs in end of oil sump and base assembly remove four nuts (13) and four washers (14).

2. Carefully pull two-stage compressor assembly off studs in sump and base. Remove shim (15) from oil sump and base.

k. (See figure 4-2.) Remove nozzle ring (16) from nozzle box by removing fastening nut on clamp and removing clamp (17). Remove wire and insulation blankets (18) and (19) from nozzle ring.

l. (See figure 4-2.) If attached, remove three engine mounts (20) (two on lower sides of two-stage compressor and one on front of sump and base section) by removing three nuts (21), three bolts (22) and six spacers (23). Remove three Lord mount brackets (24) by removing twelve bolts (25) and twelve lock washers (26).

m. (See figure 4-1.) The starter relay (23) and voltage regulator (24) should be removed from the electrical equipment box in the left side of the power package in the following manner:

1. Detach cover assembly on electrical equipment box by removing four screws.

2. Disconnect and tag wires to four terminal posts in starter relay and replace nuts and washers on posts. Remove starter relay by removing two nuts and two bolts.

3. Disconnect and tag wires to three terminal posts on voltage regulator. Replace nuts and washers after removing wires. Remove voltage regulator by unscrewing six screws attaching base of voltage regulator to bottom of electrical equipment box.

n. (See figure 4-1.) Remove lube filter (25) and its mounting bracket assembly from frame in left side of power package in following manner:

1. Disconnect tube assembly to lube and scavenge pump and unscrew nipple from boss in side of filter. Disconnect hose assembly to cross at two-stage compressor end of engine. Unscrew 45° elbow from bushing and remove reducer bushing from boss in bottom of filter.

2. Detach filter and bracket from frame by removing four nuts, four washers and four bolts.

o. (See figure 4-1.) Remove low pressure fuel filter (26) and its bracket from frame in power package in following manner:

1. Disconnect tube assembly to manual fuel valve on instrument panel and unscrew 90° elbow from forward boss in side of filter.

2. Disconnect tube assembly to fuel pump inlet and unscrew 90° elbow from outlet port in filter.

3. Detach fuel filter and bracket from frame by removing four nuts, four washers and four bolts.

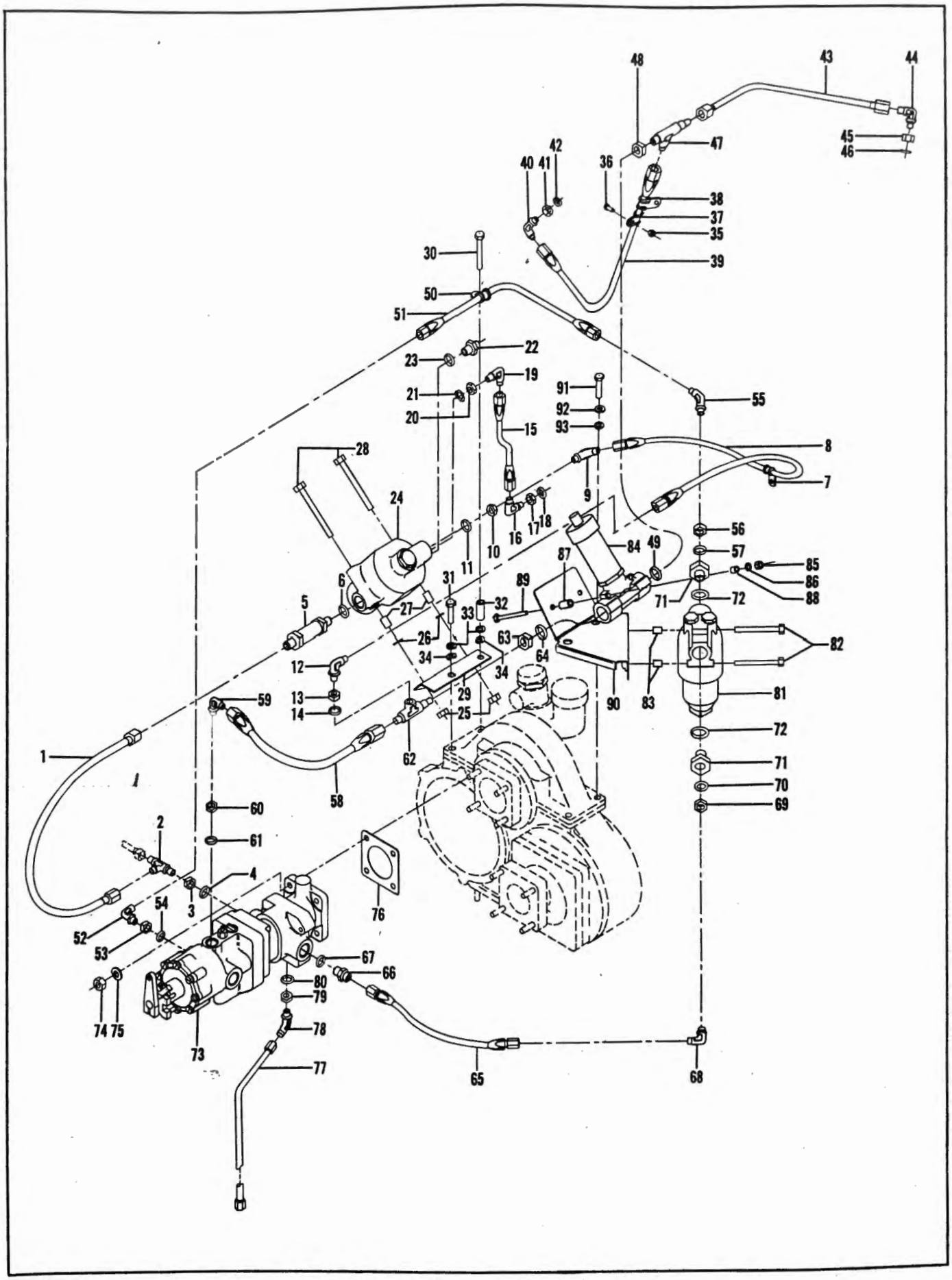


FIGURE 4-3. ENGINE FUEL SYSTEM (Sheet 2 of 2)

p. Remove exhaust temperature pyrometer (27) from instrument panel in following manner:

1. Disconnect and mark four leads to three terminals on rear of pyrometer by removing three nuts and three washers. After leads are removed, replace nuts and washers.

2. Remove pyrometer from panel by removing three screws from face of panel.

q. Remove tachometer indicator (28) from instrument panel by unscrewing electrical connector from rear of tachometer indicator and removing four screws from face of panel.

4-9. ENGINE FUEL SYSTEM.

4-10. SPECIAL TOOLS. No special tools are required for disassembly of the engine fuel system.

4-11. DISASSEMBLY. (See figure 4-3.) The fuel system should be disassembled in the following manner:

a. Remove tube assembly (1) between relief valve and tee at fuel inlet. Loosen nut and unscrew tee (2) from fuel pump inlet port. Remove nut (3) and O-ring (4) from tee. Unscrew relief valve (5) from acceleration limiter and remove O-ring (6) from valve. Remove clamp (7) from first-stage compressor case and remove hose assembly (8) from between acceleration limiter and fuel solenoid. Loosen nut and unscrew 45° elbow (9) from acceleration limiter. Remove nut (10) and O-ring (11) from elbow. Loosen nut and unscrew 90° elbow (12) from tee at fuel solenoid. Remove nut (13) and O-ring (14) from 90° elbow. Remove hose assembly (15) between compressor and acceleration limiter. Loosen nut and unscrew 90° elbow (16) from rear compressor case. Remove nut (17) and O-ring (18) from elbow. Loosen nut, unscrew 90° elbow (19) from acceleration limiter and remove nut (20) and O-ring (21) from elbow. Detach upper end of acceleration limiter drainage hose and remove union (22) and O-ring (23) from acceleration limiter.

b. Detach acceleration limiter (24) from its mounting bracket by removing two nuts (25), two washers (26), two spacers (27) and two bolts (28). Remove acceleration limiter bracket (29) from accessory drive assembly by removing two bolts (30) and (31), spacer (32), two washers (33) and two lock washers (34). Remove nut (35) from screw (36) and detach clamp (37). Remove clamp (38) from the cover plate of accessory drive end cap. Remove hose assembly (39), between fuel solenoid and left-hand nozzle. Loosen nut, unscrew 90° elbow (40) from boss in burner elbow and remove nut (41) and O-ring (42). Remove tube assembly (43), between fuel solenoid and right-hand fuel nozzle. Loosen nut, unscrew 90° elbow (44) from right-hand burner elbow and remove nut (45) and O-ring (46). Unscrew tee (47) from fuel solenoid and remove nut (48) and O-ring (49). Slip off clamp (50) and remove hose assembly (51), between fuel filter and governor. Unscrew 90° elbow (52) from governor and remove nut (53) and O-ring (54). Unscrew 45° elbow (55) from high-pressure fuel filter and remove nut (56) and O-ring (57). Remove hose assembly (58) between governor and fuel solenoid. Unscrew 90° elbow (59) from governor and remove nut (60) and O-ring (61). Unscrew tee (62) from fuel solenoid and remove nut (63) and O-ring (64). Remove hose assembly (65), between pump and filter. Unscrew union (66) from outlet port of fuel pump and remove O-ring (67). Unscrew 90° elbow (68) from high-pressure fuel filter and remove nut (69) and O-ring (70). From filter unscrew two bushings (71) and remove two O-rings (72).

c. Taking care not to bend drain tube assembly, remove fuel pump and governor assembly (73) from accessory drive by removing four nuts (74) and four washers (75). Remove gasket (76) from between pump and accessory drive pad. Remove pump-to-drain tube assembly (77). Unscrew 45° elbow (78) from bottom of pump and remove nut (79) and O-ring (80).

d. Detach high-pressure fuel filter (81) from lower mounting face of solenoid assembly bracket by removing two bolts (82) and two spacers (83).

e. Remove fuel solenoid (84) from its bracket by removing two nuts (85), two washers (86), two long spacers (87), two short spacers (88) and two bolts (89).

f. Remove solenoid assembly bracket (90) from accessory drive cover by removing two bolts (91), two lock washers (92) and two washers (93).

4-12. ENGINE LUBRICATION SYSTEM.

4-13. SPECIAL TOOLS. No special tools are required for disassembly of engine lubrication system.

4-14. DISASSEMBLY. (See figure 4-4.) The engine lubrication system should be disassembled in the following manner:

a. Remove compressor inlet tube assembly (1) between accessory drive housing of output compressor and cross which connects to tube assembly between oil manifold and output compressor. Unscrew nipple (2) from boss in accessory drive housing and unscrew cross (3) from tube assembly. Remove bolt (4), clamp (5) and spacer (6) and remove manifold to compressor tube assembly (7). Unscrew 90° elbow (8) from bottom of oil manifold.

b. Remove tube assembly (9) between accessory drive housing and compressor sump. Unscrew union (10) from the lower rear side of second-stage housing and remove O-ring (11) from union. Remove 90° elbow (12) from lower boss in accessory drive housing.

c. Remove tube assembly (13) between oil separator and rotor housing. Unscrew 45° elbow (14) from top of rotor housing and unscrew nipple (15) from side of oil separator.

d. Remove tube assembly (16) between oil separator and compressor and remove 45° elbow (17) from top of interstage housing. Loosen nut and unscrew 45° elbow (18) from bottom of oil separator. Remove nut (19) and O-ring (20) from elbow.

e. Detach clamp (21) and remove tube assembly (22) between oil separator and tee adjacent to oil sump and base assembly. Unscrew nipple (23) from bottom of oil separator. Remove clamp (24) and remove oil separator assembly (25).

f. Separate oil separator cover assembly (26) (see detail A) and gasket (27) from oil separator body (28) by removing six nuts (29), twelve washers (30) and six bolts (31). Extract oil separator strainer (32) from body.

g. Remove oil separator bracket (33) from interstage housing by removing three nuts (34), nine washers (35) and three bolts (36).

h. Detach clamp (37) and remove tube assembly (38) between tee adjacent to oil sump and base assembly

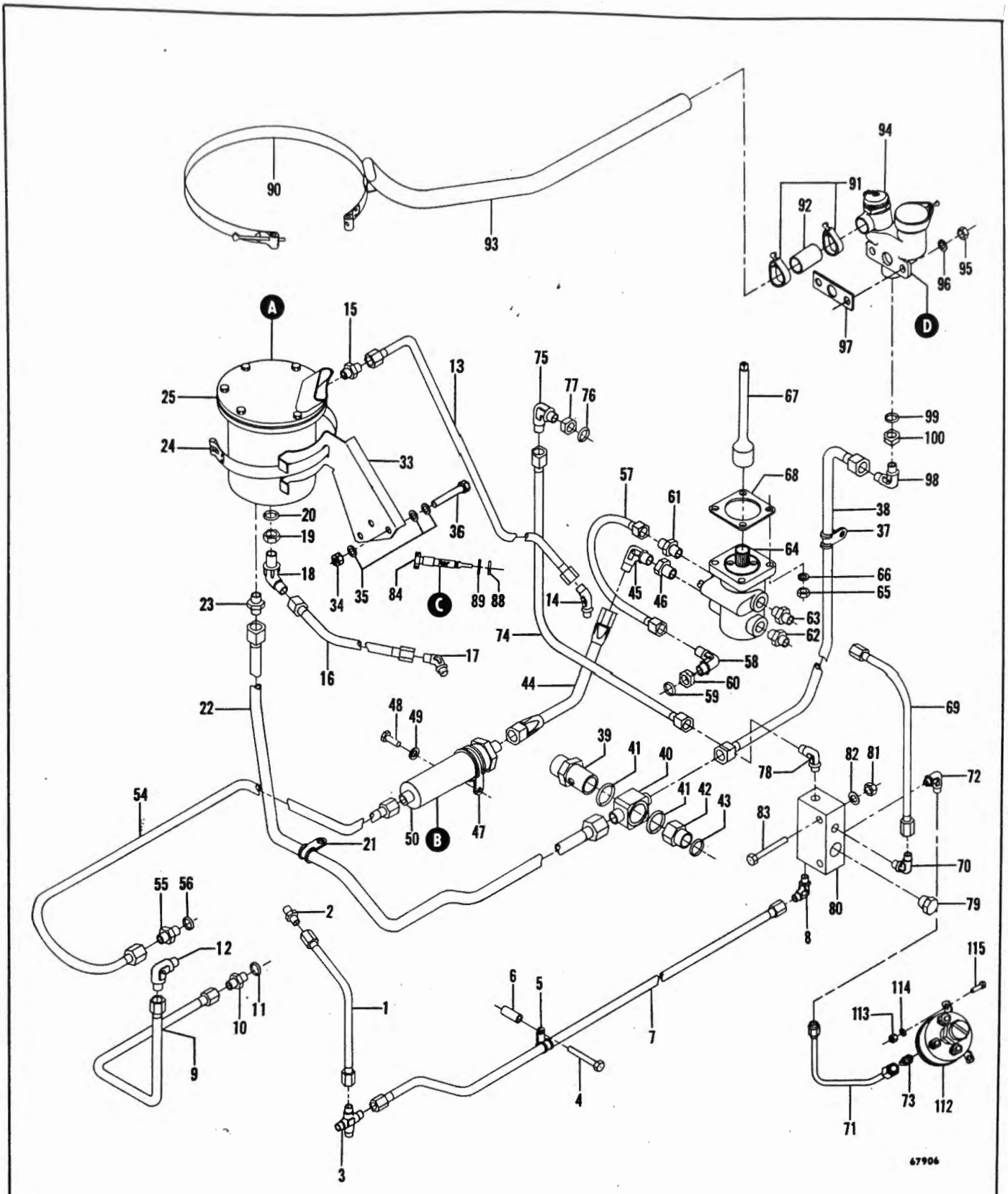


FIGURE 4-4. ENGINE LUBRICATION SYSTEM (Sheet 1 of 3)

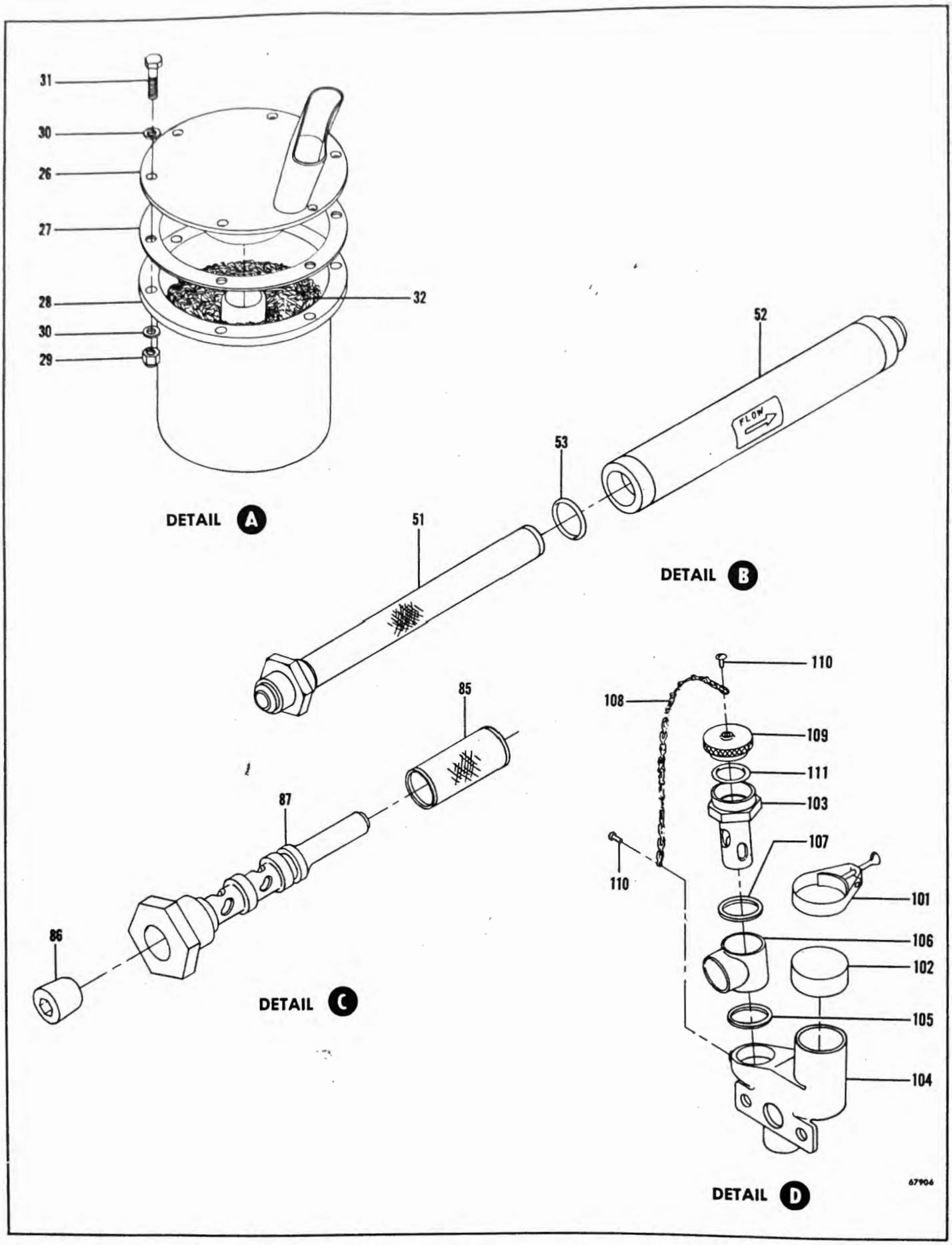


FIGURE 4-4. ENGINE LUBRICATION SYSTEM (Sheet 2 of 3)

KEY TO FIGURE 4-4.

1. COMPRESSOR INLET TUBE ASSEMBLY
2. NIPPLE
3. CROSS
4. BOLT
5. CLAMP
6. SPACER
7. MANIFOLD TO COMPRESSOR TUBE ASSEMBLY
8. ELBOW
9. COMPRESSOR TO SUMP TUBE ASSEMBLY
10. UNION
11. O-RING
12. ELBOW
13. OIL SEPARATOR TO ROTOR HOUSING TUBE ASSEMBLY
14. ELBOW
15. NIPPLE
16. OIL SEPARATOR TO COMPRESSOR TUBE ASSEMBLY
17. ELBOW
18. ELBOW
19. NUT
20. HYDRAULIC FITTING RING
21. CLAMP
22. OIL SEPARATOR TO SUMP TUBE ASSEMBLY
23. NIPPLE
24. CLAMP
25. OIL SEPARATOR ASSEMBLY
26. OIL SEPARATOR COVER ASSEMBLY
27. GASKET
28. OIL SEPARATOR BODY
29. NUT
30. WASHER
31. BOLT
32. OIL SEPARATOR STRAINER
33. OIL SEPARATOR BRACKET
34. NUT
35. WASHER
36. BOLT
37. CLAMP
38. SUMP TO BREATHER TUBE ASSEMBLY
39. BOLT
40. TEE
41. O-RING
42. BUSHING
43. O-RING
44. STRAINER TO PUMP HOSE ASSEMBLY
45. ELBOW
46. BUSHING
47. CLAMP
48. BOLT
49. WASHER
50. STRAINER ASSEMBLY
51. STRAINER
52. OUTER SHELL ASSEMBLY
53. GASKET
54. SUMP TO STRAINER TUBE ASSEMBLY
55. UNION
56. O-RING
57. OIL SUMP TO PUMP TUBE ASSEMBLY
58. ELBOW
59. O-RING
60. NUT
61. NIPPLE
62. NIPPLE
63. NIPPLE
64. LUBE AND SCAVENGE PUMP
65. NUT
66. WASHER
67. LUBE AND SCAVENGE PUMP SHAFT
68. OIL STRAINER GASKET
69. MANIFOLD TO ACCESSORY DRIVE TUBE ASSEMBLY
70. ELBOW
71. MANIFOLD TO OIL PRESSURE SWITCH TUBE ASSEMBLY
72. ELBOW
73. NIPPLE
74. MANIFOLD TO ROTOR HOUSING TUBE ASSEMBLY
75. ELBOW
76. O-RING
77. NUT
78. ELBOW
79. PLUG
80. OIL MANIFOLD
81. NUT
82. WASHER
83. BOLT
84. OIL JET ASSEMBLY
85. SCREEN
86. PLUG
87. JET
88. O-RING
89. O-RING
90. CLAMP
91. CLAMP
92. CONNECTOR SLEEVE TUBE
93. OIL BREATHER EXHAUST TUBE ASSEMBLY
94. BREATHER ASSEMBLY
95. NUT
96. WASHER
97. BREATHER BODY GASKET
98. ELBOW
99. O-RING
100. NUT
101. CLAMP
102. BREATHER BODY COVER
103. OIL BREATHER ADAPTER
104. BREATHER BODY
105. OIL BREATHER GASKET
106. TUBE ASSEMBLY
107. OIL BREATHER GASKET
108. CHAIN
109. CAP
110. SCREW
111. O-RING
112. OIL PRESSURE SWITCH
113. NUT
114. WASHER
115. BOLT

FIGURE 4-4. ENGINE LUBRICATION SYSTEM (Sheet 3 of 3)

and breather assembly.

i. Unscrew bolt (39) from tee (40) and remove two O-rings (41). Unscrew bushing (42) from oil sump and base assembly, and remove O-ring (43).

j. Remove hose assembly (44) between strainer assembly lube and scavenge pump and remove 90° elbow (45) and bushing (46) from scavenge inlet port of lube and scavenge pump.

k. Remove clamp (47) from strainer assembly by removing bolt (48) and washer (49) from sump and base assembly. Disassemble strainer assembly (50) (see detail B) by unscrewing strainer (51) from outer shell assembly (52). Remove hot oil resistant gasket (53) from strainer.

l. Disconnect tube assembly (54) from lower rear left side of compressor second-stage housing and remove union (55). Remove O-ring (56) from union.

m. Disconnect tube assembly (57) between oil sump and base assembly and pressure inlet port of lube and scavenge pump. Loosen nut and unscrew 90° elbow (58) from front of oil sump and base assembly. Remove O-ring (59) and nut (60) from elbow. Unscrew nipple from lube and scavenge pump pressure inlet port.

n. Unscrew nipple (62) from lube and scavenge pump scavenge outlet port and remove nipple (63) from lube and scavenge pump pressure outlet port. Remove lube and scavenge pump (64) by removing four nuts (65) and four washers (66), and catch lube and scavenge pump drive shaft (67) as pump is removed. Remove gasket (68) from pump mounting surface on bottom of

KEY TO FIGURE 4-5.

1. THROAT TO BRAIN CAP TUBE ASSEMBLY
2. THROAT TO BRAIN BASE TUBE ASSEMBLY
3. THROAT TO BRAIN ADAPTER TUBE ASSEMBLY
4. BYPASS VALVE TO BRAIN BASE TUBE ASSEMBLY
5. ELBOW
6. NIPPLE
7. ELBOW
8. BOLT
9. WASHER
10. WASHER
11. NUT
12. NUT
13. WASHER
14. BOLT
15. CAP
16. SPRING ANCHOR
17. SILASTIC O-RING
18. EXTENSION SPRING
19. NUT
20. WASHER
21. PLATE
22. DIAPHRAGM
23. SPACER
24. SEPARATOR
25. DIAPHRAGM
26. PLATE
27. WASHER
28. STEM
29. POPPET
30. COMPRESSION SPRING
31. SCREW
32. WASHER
33. POPPET CAGE
34. SILASTIC O-RING
35. NUT
36. BLEED NEEDLE
37. SILASTIC O-RING
38. BASE
39. BUSHING
40. PLATE
41. BOLT
42. WASHER
43. WASHER
44. COVER
45. SCREW
46. WASHER
47. WASHER
48. WASHER
49. GASKET
50. HEX NUT
51. WASHER
52. VALVE
53. SPRING PIN
54. STUD
55. BYPASS VALVE PISTON
56. BODY
57. BYPASS VALVE GASKET
58. THROAT
59. BOLT
60. WASHER
61. WASHER
62. THROAT TO VENTURI GASKET
63. BOLT
64. WASHER
65. WASHER
66. SCREW
67. BUSHING
68. GASKET
69. SHAFT
70. DISC
71. HOUSING
72. CHECK VALVE TO VENTURI GASKET
73. VENTURI EXPANDER

FIGURE 4-5. AIR FLOW CONTROL ASSEMBLY (Sheet 1 of 2)

rotor housing.

o. Disconnect tube assembly (69) between oil manifold and engine accessory drive assembly and unscrew 90° elbow (70) from side of oil manifold.

p. Remove tube assembly (71) between manifold and oil pressure switch and remove 90° elbow (72) from front of oil manifold. Unscrew nipple (73) from bottom of oil pressure switch.

q. Disconnect tube assembly (74) between manifold and rotor housing. Loosen nut and unscrew 90° elbow (75) from boss on left side of rotor housing. Remove O-ring (76) and nut (77) from elbow. Unscrew 90° elbow (78) from top of oil manifold.

r. Remove pipe plug (79) from side of manifold and remove oil manifold (80) from its bracket by removing two nuts (81), two washers (82) and two bolts (83).

s. Unscrew oil jet assembly (84) (see detail C) from left side of rotor housing. Disassemble oil jet by removing strainer (85) and plug (86) from jet (87). Remove O-rings (88) and (89) from jet.

t. Remove clamp (90) from left exhaust stack and from oil breather exhaust tube assembly. Remove two hose clamps (91) and pull tube connector sleeve (92) from oil breather exhaust tube assembly (93) and from breather assembly (94).

u. Remove breather from accessory drive assembly by removing two nuts (95) and two washers (96). Remove breather body gasket (97). Loosen nut and unscrew 90° elbow (98) from bottom of breather assembly. Remove O-ring (99) and nut (100) from elbow.

v. Remove hose clamp (101) (see detail D) and breather body cover (102) from top of breather assembly. Unscrew cap and allow it to hang by chain. Unscrew oil breather adapter (103) and tube assembly from breather body (104) and remove oil breather gasket (105). Pull tube assembly (106) from adapter and remove oil breather gasket (107). Remove chain (108) from body and from breather cap (109) by removing two screws (110). Remove O-ring (111) from cap.

w. Remove oil pressure switch (112) from its bracket by removing two nuts (113), two washers (114) and two bolts (115).

4-15. AIR FLOW CONTROL ASSEMBLY.

4-16. SPECIAL TOOLS. No special tools are required for removal or disassembly of air flow control assembly.

4-17. REMOVAL. (See figure 4-2.) Refer to paragraph 4-8 for removal of the air flow control assembly.

4-18. DISASSEMBLY. (See figure 4-5.) The air flow control assembly should be disassembled in the following manner:

a. Disconnect and remove tube assemblies: throat to brain cap (1), throat to brain base (2), throat to brain adapter (3), and bypass valve to brain base (4). Remove five 90° elbows (5) as follows: two from throat, one from brain cap, one from bypass valve cover and one from brain base. Remove two nipples (6), one from throat and one from brain base. Remove 45° elbow (7) from brain base.

b. Detach brain assembly by removing four bolts (8), four lock washers (9) and four washers (10) from base. Remove nut (11), ten nuts (12), twenty washers (13), ten bolts (14) and lift off brain cap (15). Detach spring anchor (16) from extension spring and remove O-ring

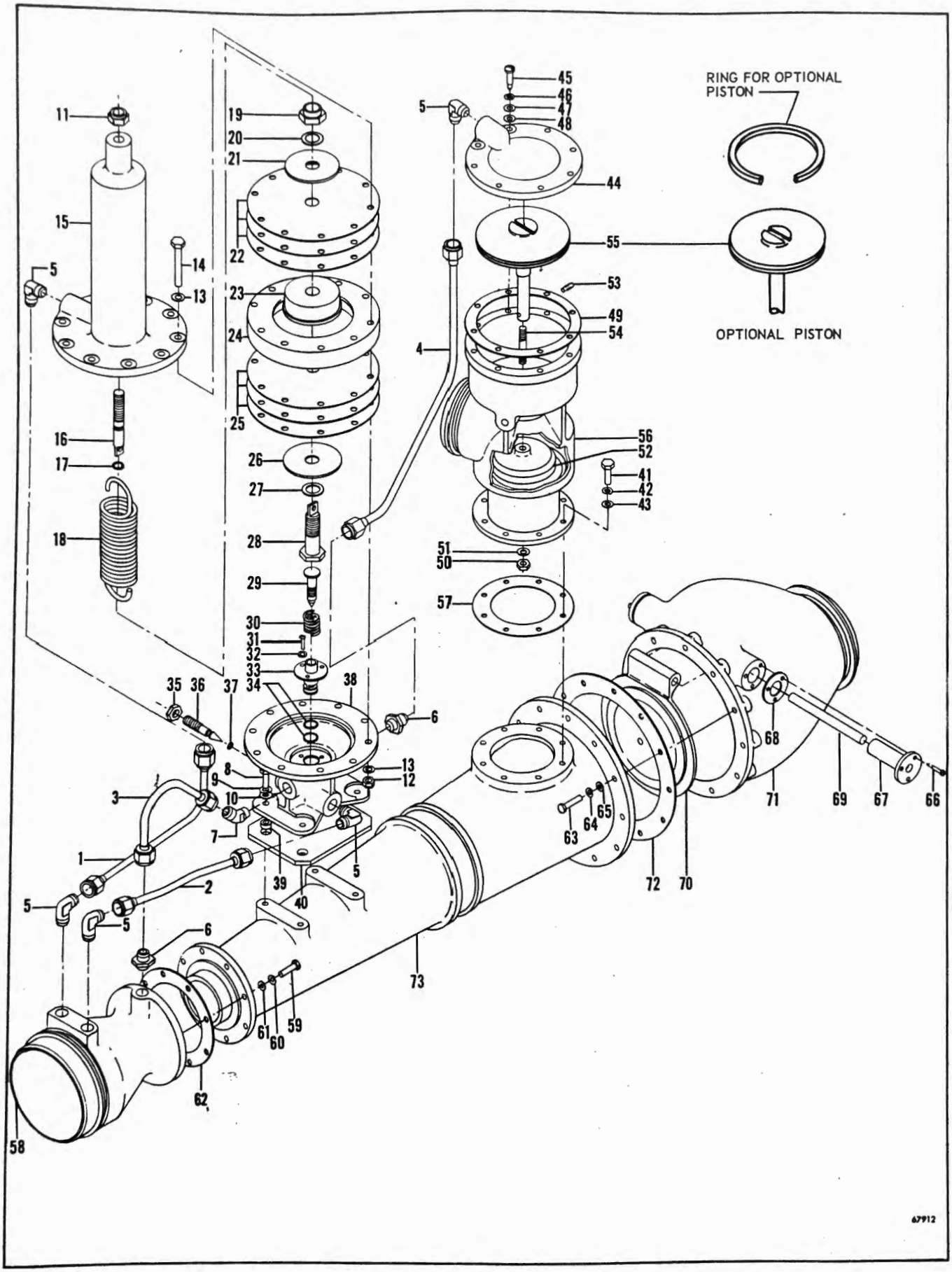


FIGURE 4-5. AIR FLOW CONTROL ASSEMBLY (Sheet 2 of 2)

KEY TO FIGURE 4-6.

1. AIR COLLECTOR ASSEMBLY
2. CLAMP
3. TUBE CONNECTOR SLEEVE
4. BOLT
5. LOCKWASHER
6. WASHER
7. SECOND-STAGE TUBE ASSEMBLY
8. GASKET
9. BOLT
10. LOCK WASHER
11. WASHER
12. FIRST-STAGE TUBE ASSEMBLY
13. GASKET
14. SILICONE RUBBER GASKET
15. NUT
16. WASHER
17. PIPE PLUG
18. OIL JET
19. BEARING
20. ACCESSORY DRIVE HOUSING
21. SHAFT ADAPTER
22. SCREW
23. RETAINER KEY
24. SET SCREW
25. NUT
26. LOCKING SLUG
27. SNAP RING
28. NUT
29. WASHER
30. BOLT
31. NUT
32. WASHER
33. STAY BOLT
34. FIRST-STAGE HOUSING
35. INSERT BEARING RETAINER
36. COMPRESSOR BUSHING
37. ROLLER BEARING
38. OIL SLINGER
39. FIRST STAGE IMPELLER ASSEMBLY
40. SPACER
41. NUT
42. WASHER
43. BOLT
44. BOLT
45. STAY BOLT
46. REAR HOIST FITTING
47. INTERSTAGE HOUSING
48. INTERSTAGE AIR SEAL
49. SECOND-STAGE IMPELLER ASSEMBLY
50. SPACER
51. BOLT
52. WASHER
53. CAP ASSEMBLY
54. OIL SLINGER
55. BEARING RETAINER PLATE
56. BALL BEARING
57. BEARING RETAINER
58. WHEEL AND SHAFT ASSEMBLY
59. BOLT
60. LOCK WASHER
61. WASHER
62. INNER CONE ASSEMBLY
63. BOLT
64. BEARING CAP ASSEMBLY
65. BEARING RETAINER PLATE
66. FLOATING BEARING
67. BEARING RETAINER
68. PIPE PLUG
69. SECOND-STAGE HOUSING

FIGURE 4-6. TWO-STAGE COMPRESSOR ASSEMBLY (Sheet 1 of 2)

(17) from spring anchor. Detach extension spring (18) from stem in brain base. From stem remove nut (19), washer (20), plate (21), three diaphragms (22) and spacer (23). From brain base remove separator (24) and remove three diaphragms (25), plate (26) and washer (27) from stem. Lift stem (28), poppet (29) and compression spring (30) from top of poppet cage. Remove three machine screws (31), three lock washers (32) and poppet cage (33) from brain base. Remove two O-rings (34) from poppet cage. Unscrew nut (35) from needle and unscrew needle (36) from brain base. Remove O-ring (37) from needle. Set aside brain base (38).

c. Press four bushings (39) from plate (40).

d. Detach bypass valve from gasket and venturi expander by removing eight bolts (41), eight lock washers (42) and eight washers (43). Remove cover (44) from body by removing eight machine screws (45), eight lock washers (46), eight washers (47) and eight washers (48). Lift off gasket (49). Extract valve and piston from body by removing nut (50) and washer (51). The valve (52) must be withdrawn from the body through the bypass valve exhaust port. Disassemble piston and stud assembly by driving spring pin (53) from shaft of piston and unscrewing stud (54) from piston (55). Set aside body (56) and gasket (57).

e. Remove throat (58) from venturi expander by removing eight bolts (59), eight lock washers (60) and eight washers (61). Remove gasket (62).

f. Detach check valve assembly from venturi expander by removing twelve bolts (63), twelve lock washers (64) and twelve washers (65). Break lockwire and remove six screws (66) which attach two bushings (67) and two gaskets (68). Shaft (69) and disc (70) can now be removed from housing (71). Remove gasket (72) from venturi expander (73).

4-19. TWO-STAGE COMPRESSOR ASSEMBLY.

4-20. SPECIAL TOOLS. For special tools required in disassembly of the two-stage compressor assembly, refer to Section III, table II, group nine.

4-21. REMOVAL. (See figure 4-2.) Refer to paragraph 4-8 for removal of two-stage compressor assembly.

4-22. DISASSEMBLY. (See figure 4-6.) Disassemble the two-stage compressor assembly in the following manner:

a. Place two-stage compressor assembly, wheel end down, on an improvised stand.

CAUTION

Place wheel on rubber or fiber mat and take care not to damage turbine blades on wheel and shaft assembly.

b. Loosen eight clamps securing air collector assembly (1) to the output compressor section. Remove air collector assembly and clamps (2). Loosen eight clamps (2) and remove eight tube connector sleeves (3). Remove bolts (4), lock washers (5) and washers (6) which secure each of eight second-stage tube assemblies (7) and gaskets (8). Remove two bolts (9), lock washers (10) and washers (11) which secure each of eight first-stage tube assemblies (12) and gaskets (13) and (14).

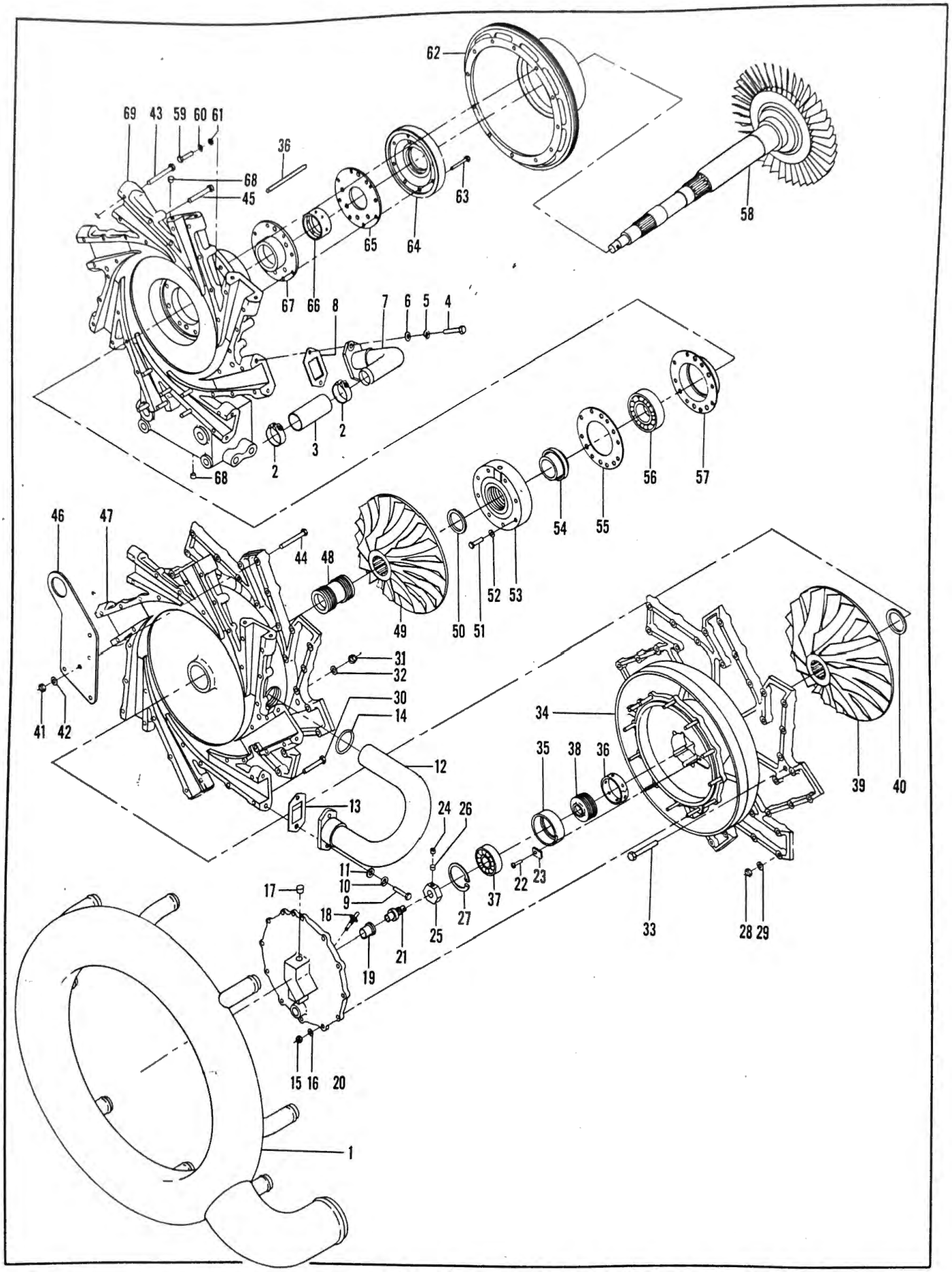
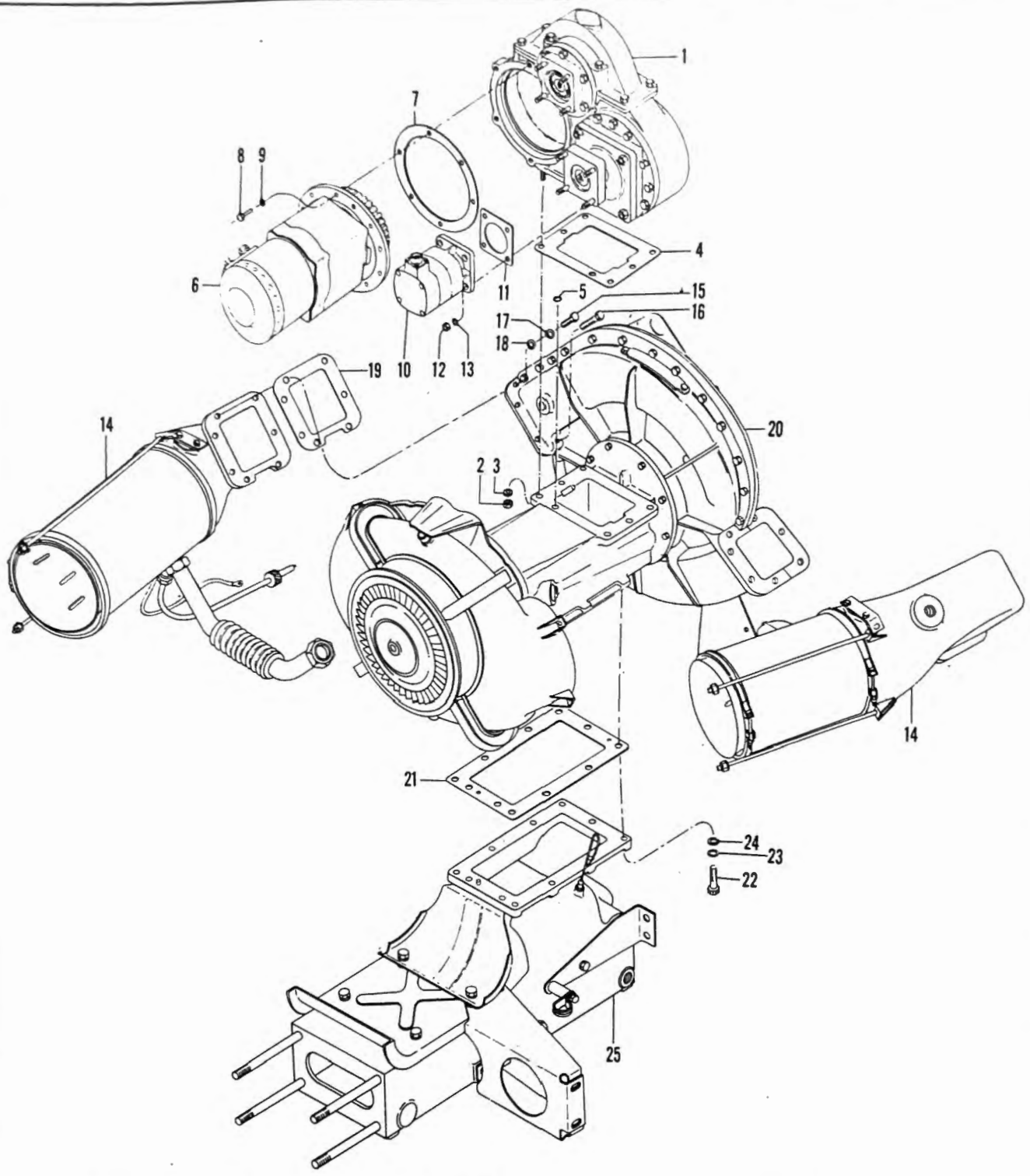


FIGURE 4-6. TWO-STAGE COMPRESSOR ASSEMBLY (Sheet 2 of 2)



1. ACCESSORY DRIVE ASSEMBLY
2. NUT
3. WASHER
4. GASKET
5. O-RING
6. STARTER-GENERATOR
7. GASKET
8. BOLT
9. WASHER
10. TACHOMETER GENERATOR
11. GASKET
12. NUT
13. WASHER
14. BURNER SECTION
15. BOLT
16. BOLT
17. WASHER
18. WASHER
19. GASKET
20. ROTOR SECTION
21. GASKET
22. BOLT
23. WASHER
24. WASHER
25. SUMP AND BASE SECTION

FIGURE 4-7. GAS PRODUCER SECTION

c. Remove 12 nuts (15) and washers (16) which secure the accessory drive housing assembly. Disassemble the housing assembly by removing the pipe plug (17), oil jet (18) and bearing (19) from the accessory drive housing (20).

d. Remove shaft adapter (21) from end of wheel and shaft assembly. Remove screw (22) which secures retainer key (23) to the first-stage housing, and remove key

e. Remove set screw (24) using special tools in group nine, and hold wheel and shaft assembly (see figure 7-10) and remove nut (25). Press locking slug (26) from nut after removal. Remove snap ring (27) from first-stage housing.

f. Remove 41 nuts (28), washers (29) and bolts (30) which secure the first-stage housing to the interstage housing. Remove two nuts (31), washers (32) and stay bolts (33) and remove first-stage housing (34). Remove insert bearing retainer (35) together with bearing outer race from the first-stage housing. If damaged or deeply grooved, remove compressor bushing (36) by pressing out of bore in forward side of first-stage housing.

g. Remove roller bearing (37), two-stage compressor oil slinger (38), first-stage impeller assembly (39) and spacer (40) by lifting from wheel and shaft assembly.

h. Remove 40 nuts (41), washers (42), and 30 bolts (43), three bolts (44) and two bolts (45). Remove the rear hoist fitting (46). Remove the two remaining stay bolts that secure the interstage housing to the second-stage housing, and remove the interstage housing (47).

i. Remove air seal (48), second-stage impeller assembly (49) and spacer (50) from top of oil slinger.

j. Remove lockwire and eight bolts (51), washers (52) which secure bearing cap assembly to second-stage housing. Remove bearing cap assembly (53), oil slinger (54), bearing retainer plate (55), ball bearing (56) and ball bearing retainer (57) from second-stage housing. Pull wheel and shaft assembly (58) from housing.

k. Remove 12 bolts (59), lock washers (60) and washers (61) which secure exhaust collector inner cone assembly to the second-stage housing. Remove the inner cone (62).

l. Invert second-stage housing and remove lockwire, eight bolts (63) which secure the bearing cap assembly to the second-stage housing. Remove the bearing cap assembly (64), bearing retainer plate (65), floating bearing (66) and bearing retainer (67) from the second-stage housing.

m. Remove two pipe plugs (68) from second-stage housing (69).

NOTE

The entire rotor assembly, consisting of wheel and shaft assembly, both impellers, bearings, spacers, oil slingers and air seal is a carefully balanced assembly and must always be replaced as a unit.

4-23. GAS PRODUCER SECTION.

4-24. SPECIAL TOOLS. For special tools required in disassembly of the gas producer section, refer to Section III, table II, group one.

4-25. DISASSEMBLY. (See figure 4-7.) Disassemble the gas producer section in the following manner:

a. Using the special tool in group one (see figure 7-9) remove the accessory drive assembly (1), with the starter-generator and tachometer generator attached, by removing six nuts (2) and six washers (3). Remove gasket (4) and O-ring (5). Remove starter (6) and gasket (7), by removing six bolts (8) and six washers (9). Remove tachometer generator (10) and gasket (11) by removing four nuts (12) and washers (13).

NOTE

Starter-generator must be removed with the accessory drive assembly as there is insufficient end clearance for individual removal.

b. Remove burner section (14) in the following manner:

NOTE

For the keyed index items of step b, see figure 4-9.

1. Remove each burner by removing two nuts (1), two special washers (2), two washers (3) and two tie bolts (4).

2. Detach glow coil cable (5) by removing nut (6), washer (7) and screw (8).

3. Remove igniter lead (9).

4. Remove crossfire tube (10) by loosening large hex nuts at each end. Remove nipple (11) and ball sleeve (12).

5. Loosen clamp (13) at nozzle box end of burner shell and slip forward onto burner shell.

NOTE

For the keyed index items in steps c, d and e, see figure 4-7.

c. Remove five bolts (15), two bolts (16), seven washers (17), seven washers (18), and gasket (19) which secure each burner elbow assembly to the compressor casing, and remove remaining burner parts as a unit from the nozzle box flange by gently working forward.

d. Remove the rotor section (20) and gasket (21) from the sump and base section by removing 11 bolts (22), 11 washers (23) and 11 lock washers (24). Lift rotor section from sump and base section (25).

NOTE

It is recommended for convenience that the rotor section be disassembled prior to removal of the rotor section from the sump and base section. For disassembly of the rotor section, refer to paragraph 4-37.

e. For removal of the sump and base section, see paragraph 4-25d above.

KEY TO FIGURE 4-8.

1. NUT
2. WASHER
3. BOLT
4. SPECIAL LOCK WASHER
5. GEAR RETAINER PLATE
6. GEAR RETAINER SPACER
7. INPUT GEAR
8. OUTPUT GEAR
9. GEAR PLUG
10. OIL SEAL
11. TACHOMETER DRIVE ACCESSORY PAD
12. GASKET
13. BOLT
14. WASHER
15. WASHER
16. LOCK NUT
17. LOCK WASHER
18. 81-TOOTH GEAR
19. BEARING
20. BEARING
21. INTERNAL RETAINER RING
22. SPACER
23. ACCESSORY PAD
24. BOLT
25. WASHER
26. WASHER
27. BEARING CAP
28. BOLT
29. WASHER
30. BEARING CAP SHIM
31. LUBE JET NOZZLE
32. O-RING
33. NUT
34. BOLT
35. WASHER
36. WASHER
37. END CAP
38. BOLT
39. WASHER
40. WASHER
41. BOLT
42. WASHER
43. WASHER
44. COVER
45. BODY
46. BUSHING
47. LOCK NUT
48. LOCK WASHER
49. 81-TOOTH GOVERNOR DRIVE GEAR
50. NEOPRENE PLUG
51. BEARING
52. BEARING
53. INTERNAL RETAINER RING
54. SPACER
55. INTERNAL RETAINER RING
56. ACCESSORY PAD
57. BEARING
58. EXTERNAL RETAINER RING
59. CLUSTER GEAR
60. WOODRUFF KEY
61. BOLT
62. 57-TOOTH GEAR
63. 96-TOOTH GEAR
64. BOLT
65. WASHER
66. WASHER
67. COVER PLATE
68. GASKET
69. LOCK NUT
70. LOCK WASHER
71. HELICAL GEAR
72. WOODRUFF KEY
73. SHIM
74. PLATE
75. SCREW
76. BEARING
77. SPINDLE

FIGURE 4-8. ACCESSORY DRIVE ASSEMELY (Sheet 1 of 2)

4-26. ACCESSORY DRIVE ASSEMBLY.

4-27. SPECIAL TOOLS. For special tools required in disassembly of the accessory drive, refer to Section III, table II, groups six, seven and eight.

4-28. REMOVAL. Refer to paragraph 4-25 for removal of accessory drive assembly.

4-29. DISASSEMBLY. (See figure 4-8.) The accessory drive assembly should be disassembled in the following manner:

NOTE

All bearings in this assembly are press fit and should be removed by gently wedging with two thin-bladed screw drivers. However, if much pressure is applied, the bearings must be considered damaged and should be replaced. All bearings and gears should be handled with care to prevent damage.

a. Remove tachometer drive accessory pad from accessory pad by removing four nuts (1) and eight washers (2).

b. Disassemble gear retaining group by straightening locking tabs of lock washer from bolt heads and plate and removing two bolts (3), two special lock washers (4), gear retainer plate (5) and two gear retainer spacers (6). Pull out input gear (7) and output gear (8) and tap gear plug (9) from output gear. Hook oil seal (10) from tachometer drive accessory pad (11).

NOTE

The bearings for the input and output gears should not be removed. If bearings are damaged the pad assembly should be replaced.

Remove gasket (12) from accessory pad.

c. Detach tachometer generator accessory pad assembly from accessory drive body by removing twelve bolts (13), twelve lock washers (14) and twelve washers (15). Carefully pull accessory pad assembly from body. Straighten locking tabs of lock washer from recesses in lock nut. Using special tool, group six (see figure 7-3) and with gear held in vise having copper or lead jaws, unscrew lock nut (16) and remove lock washer (17) from key slot in gear threads. Pull out 81-tooth gear (18) and bearings (19) and (20), taking care not to drop or damage them. Remove two internal retainer rings (21) and spacer (22) from accessory pad (23).

d. Disassemble accessory drive housing machining assembly into its three principal parts by removing six bolts (24), six washers (25) and six washers (26) from accessory pad. Remove bearing cap (27) from front of end cap by cutting lockwire and removing four bolts (28) and four washers (29). Screw two of these

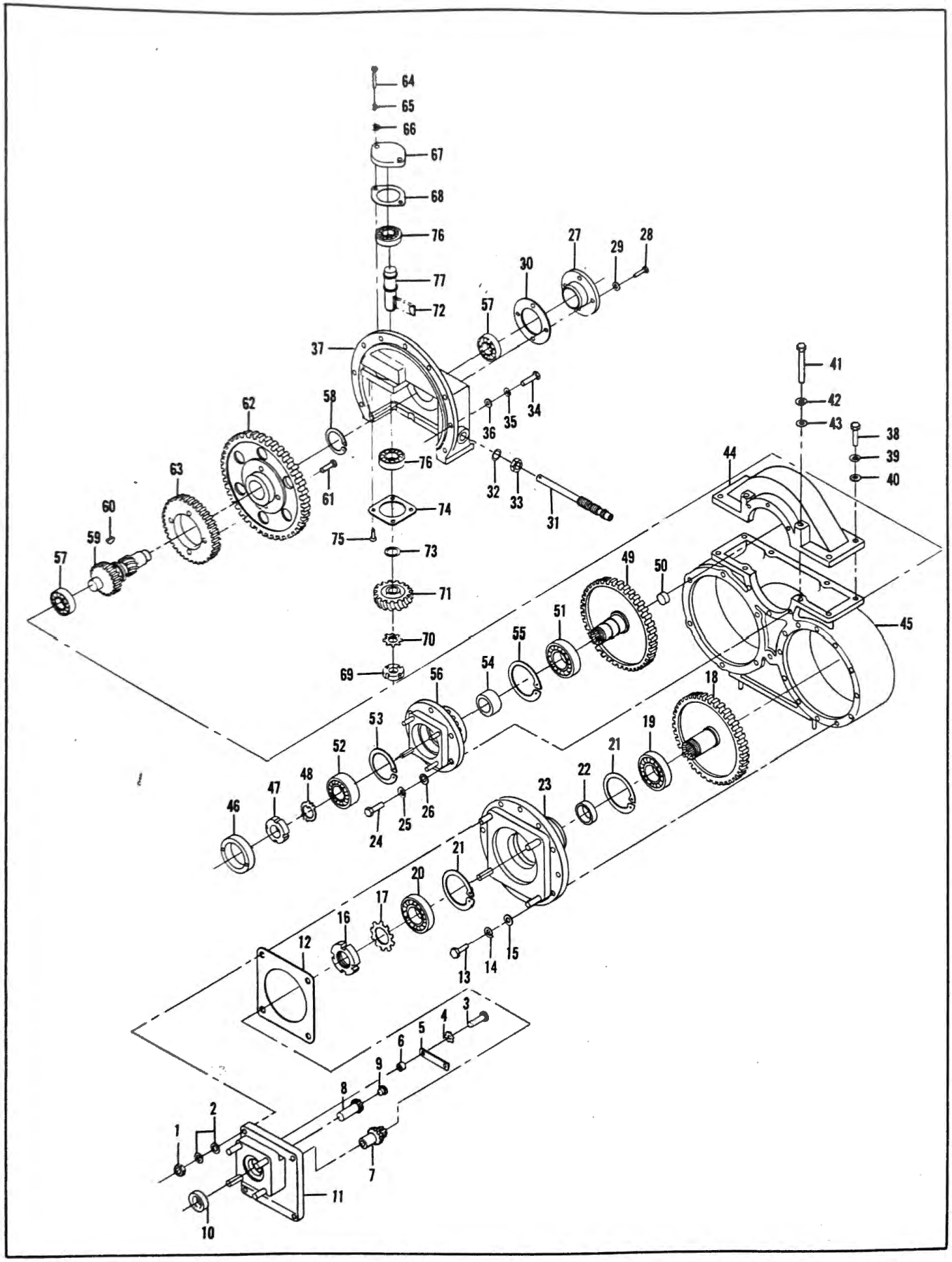
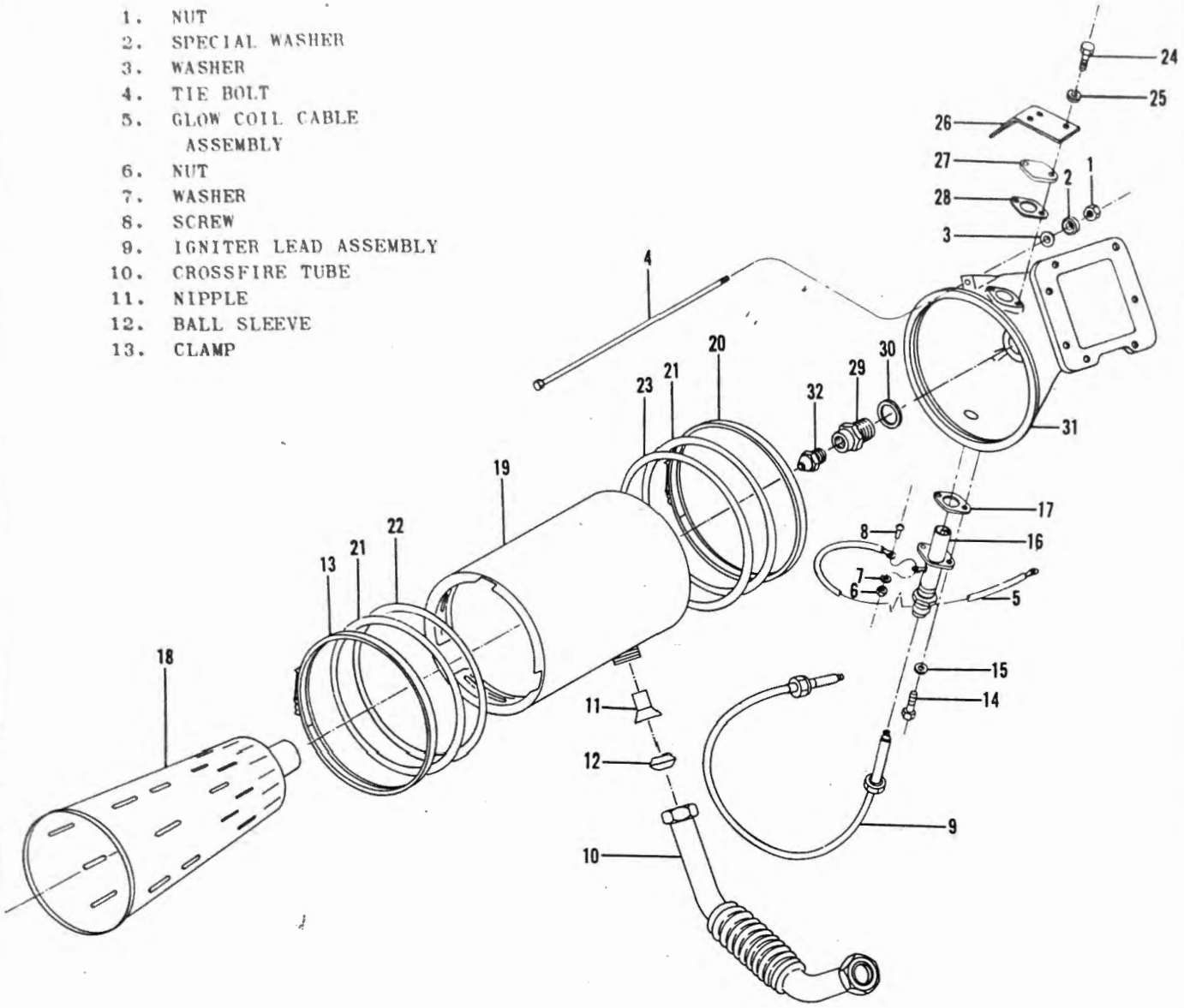


FIGURE 4-8. ACCESSORY DRIVE ASSEMBLY (Sheet 2 of 2)



1. NUT
2. SPECIAL WASHER
3. WASHER
4. TIE BOLT
5. GLOW COIL CABLE ASSEMBLY
6. NUT
7. WASHER
8. SCREW
9. IGNITER LEAD ASSEMBLY
10. CROSSFIRE TUBE
11. NIPPLE
12. BALL SLEEVE
13. CLAMP
14. BOLT
15. WASHER
16. VAPOR SPARK PLUG ASSEMBLY
17. GASKET
18. LINER ASSEMBLY
19. BURNER SHELL ASSEMBLY
20. CLAMP
21. GASKET
22. BURNER SEAL RING
23. BURNER SEAL RING
24. BOLT
25. WASHER
26. BRACKET
27. COVER
28. GASKET
29. FUEL NOZZLE ADAPTER
30. SHIM
31. BURNER ELBOW ASSEMBLY
32. FUEL NOZZLE ASSEMBLY

FIGURE 4-9. BURNER SECTION

bolts into two jacking holes and remove bearing cap from bearing and end cap. Remove bearing cap shim (30). Loosen nut, and unscrew lube jet nozzle (31) from its boss in cover. Remove O-ring (32) and flared tube nut (33) from jet nozzle. From end cap remove nine bolts (34), nine washers (35), and nine washers (36), and remove end cap (37) from body. From corners of cover, remove four bolts (38), four washers (39) and four washers (40). From raised bolt bosses on cover, remove four bolts (41), four washers (42), four washers (43) and detach cover (44) from body (45).

e. Lift accessory pad assembly from accessory drive body and carefully pull out bushing (46) and straighten locking tabs of lock washer from lock nut. Using special tool, group seven (see figure 7-3), and with gear held in vise having copper or lead jaws, unscrew lock nut (47) and slide lock washer (48) from key slot in gear threads. Pull out 81-tooth governor drive gear (49) and tap out neoprene plug (50) from gear. Carefully pull out bearings (51) and (52) and remove internal retainer ring (53) and spacer (54). Remove internal retainer ring (55) from accessory pad (56).

f. Carefully pull 96-tooth gear group from front of accessory drive body. Remove two bearings (57) from the end of the cluster gear spindle and remove external snap ring (58). Carefully press cluster gear (59) from two bolted gears, taking care not to drop and lose key, and remove Woodruff key (60) from its recess in cluster gear. Unscrew four staked bolts (61) and separate 57-tooth gear (62) from 96-tooth gear (63).

g. Remove two bolts (64), two washers (65) two washers (66) and remove cover plate (67) and gasket (68) from top of end cap. Straighten locking tabs of lock washer and using special tool, group eight (see figure 7-3), unscrew lock nut (69) from spindle. Push spindle up through bronze helical gear and catch lock washer (70), helical gear (71), Woodruff key (72), and shim (73), if shim is present. Remove plate (74) by removing four screws (75) and extract spindle and two bearings from end cap. Remove two bearings (76) from oil pump drive spindle (77).

4-30. BURNER SECTION.

4-31. SPECIAL TOOLS. No special tools are required for removal or disassembly of the burner section.

4-32. REMOVAL. Refer to paragraph 4-25 for removal of the burner section.

4-33. DISASSEMBLY. (See figure 4-9.) Disassemble each burner of burner section in the following manner:

a. Remove two bolts (14) and two washers (15) which secure vapor spark plug to burner elbow assembly and remove vapor spark plug (16) and gasket (17).

b. Remove liner assembly (18) from burner shell by pulling from flared end.

c. Loosen forward clamp and slip onto burner shell. Remove burner shell assembly (19) by pulling from flange in burner elbow.

d. Remove clamps (13) and (20), two gaskets (21) and burner seal rings (22) and (23) by slipping from ends of burner shell.

e. Remove two bolts (24) and two washers (25), which secure bracket (26), cover (27) and gasket (28) to elbow assembly.

f. Remove fuel nozzle adapter (29) and shim (30) from burner elbow assembly (31). Remove fuel nozzle (32) from adapter.

4-34. ROTOR SECTION.

4-35. SPECIAL TOOLS. For special tools required in disassembly of the rotor section refer to Section III, table II, group three, five and ten.

4-36. REMOVAL. Refer to paragraph 4-25 for removal of rotor section.

4-37. DISASSEMBLY. (See figure 4-10.) Disassemble the rotor section in the following manner:

a. Remove the compressor to rotor housing tube assembly (1). Remove elbow (2) from rotor housing. Loosen nut (3) and remove the elbow (4) and O-ring (5) from the rear compressor casing.

b. Remove both igniter coils (6) by removing four nuts (7), four washers (8) and four bolts (9).

c. Remove ignition coil brackets (10) and (11) by removing four nuts (12), four washers (13), four bolts (14) and four spacers (15).

d. Remove the hoist fitting (16) by removing three nuts (17), three washers (18) and three bolts (19).

e. Disassemble the front compressor casing by removing 18 nuts (20), 18 washers (21) and 18 bolts (22), three nuts (23), three washers (24) and three stay bolts (25). Remove front compressor casing (26).

f. Remove cotter pin (27) from impeller fairing nut and using special tool group three (see figure 7-6) remove impeller fairing nut (28).

g. Remove cotter pin (29) from impeller nut. Install special tool group five, (see figure 7-5) on impeller assembly so that cap screws in wrench assembly are threaded into two holes in forward face of the impeller assembly. Use special tool to prevent impeller from turning and remove impeller nut (30) from end of wheel and shaft assembly with a socket wrench. Remove impeller nut washer (31) from end of wheel and shaft assembly.

h. Install special tool group five, (see figure 4-11) on threaded end of wheel and shaft assembly and use a standard puller to remove impeller assembly (32) from the wheel and shaft assembly. Remove square key (33) from groove in shaft.

i. .Remove lockwire and eight bolts (34) and washers (35) which secure bearing cap, oil slinger, retainer plate and bearing retainer to front of rotor housing. Remove bearing cap (36), oil slinger (37) and bearing retainer plate (38).

j. Working through the top of the rotor housing, install special tool, group 10, (see figure 4-12) so that small wedge is against rotor housing and large wedge fills space between small wedge and end of the pinion. Using a standard puller, threaded into two of the eight bolt holes, push wheel and shaft assembly through the ball bearing in the retainer. Remove wheel and shaft assembly (39). Remove woodruff key (40). Remove special tool and pinion (41).

NOTE

Do not allow pinion to drop down into rotor housing.

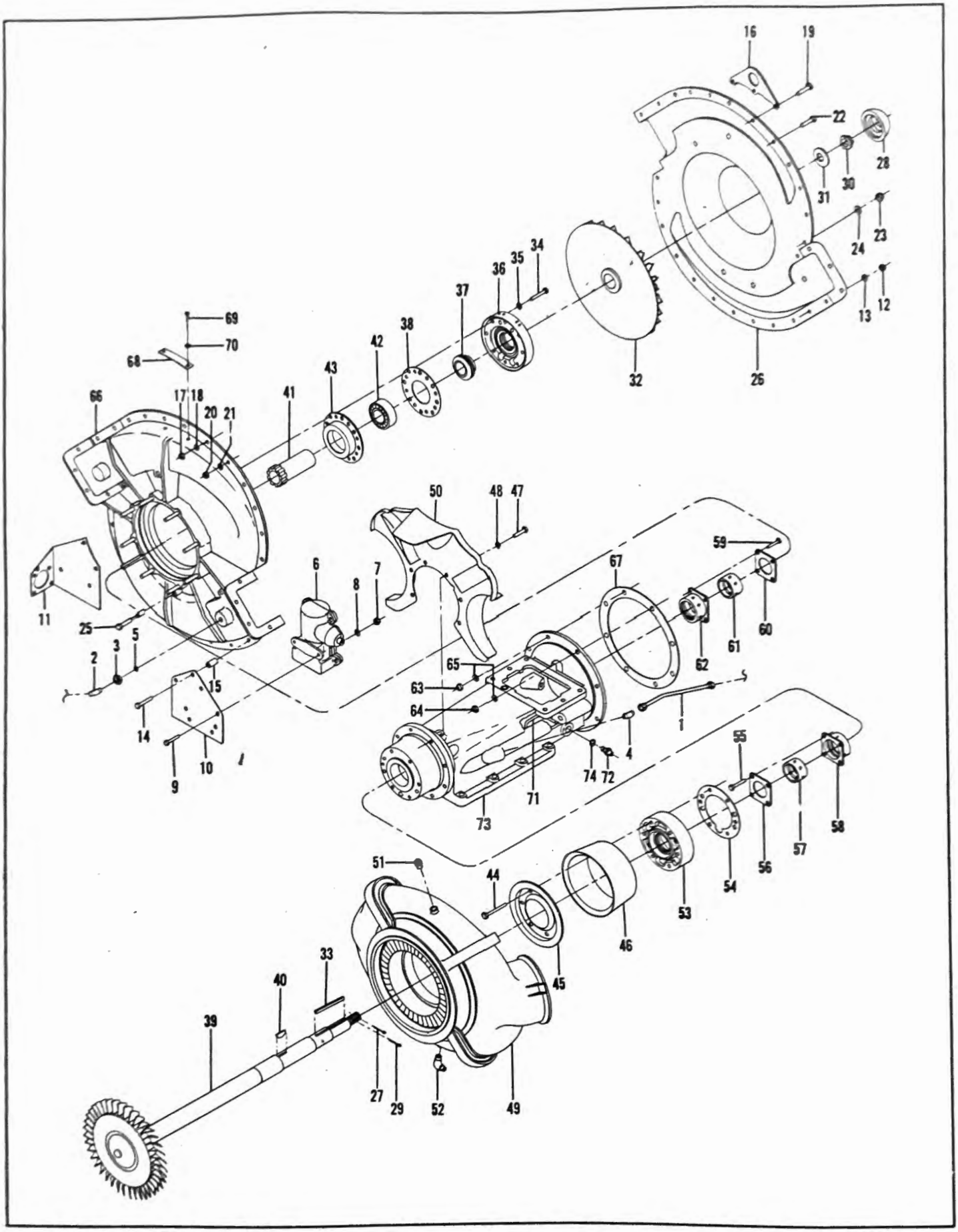


FIGURE 4-10. ROTOR SECTION (Sheet 1 of 2)

KEY TO FIGURE 4-10.

1. COMPRESSOR TO ROTOR TUBE ASSEMBLY
2. ELBOW
3. NUT
4. ELBOW
5. O-RING
6. IGNITER COIL ASSEMBLY
7. NUT
8. WASHER
9. BOLT
10. IGNITION COIL BRACKET
11. IGNITION COIL BRACKET
12. NUT
13. WASHER
14. BOLT
15. SPACER
16. HOIST FITTING
17. NUT
18. WASHER
19. BOLT
20. NUT
21. WASHER
22. BOLT
23. NUT
24. WASHER
25. STAY BOLT
26. FRONT COMPRESSOR CASING
27. PIN
28. IMPELLER FAIRING NUT
29. PIN
30. IMPELLER NUT
31. IMPELLER NUT WASHER
32. 28-BLADE IMPELLER ASSEMBLY
33. SQUARE KEY
34. BOLT
35. WASHER
36. BEARING CAP ASSEMBLY
37. OIL SLINGER
38. RETAINER PLATE
39. TURBINE WHEEL AND SHAFT ASSEMBLY
40. KEY
41. 24 TOOTH DRIVE PINION
42. BEARING
43. BEARING RETAINER
44. BOLT
45. AIR DEFLECTOR
46. INSULATING RING ASSEMBLY
47. BOLT
48. WASHER
49. NOZZLE BOX ASSEMBLY
50. FIRST-STAGE HEATSHIELD
51. PRESSURE TAP PLUG
52. SPECIAL ELBOW
53. BEARING CAP AND OIL SEAL ASSEMBLY
54. GASKET
55. BOLT
56. RETAINER PLATE
57. FLOATING BEARING
58. BEARING RETAINER
59. BOLT
60. RETAINER PLATE
61. FLOATING BEARING
62. BEARING RETAINER
63. NUT
64. NUT
65. WASHER
66. REAR COMPRESSOR CASE
67. SHIM
68. NAME PLATE
69. SCREW
70. WASHER
71. TUBE ASSEMBLY
72. UNION
73. ROTOR HOUSING ASSEMBLY
74. O-RING

FIGURE 4-10. ROTOR SECTION (Sheet 2 of 2)

k. Remove bearing retainer and ball bearing from rotor housing. Separate bearing (42) from bearing retainer (43).

l. Remove the lockwire and six bolts (44) which secure air deflector, insulating ring assembly, bearing cap and oil seal assembly and the bearing retainer gasket to rear of the rotor housing. Remove the air deflector (45), insulating ring assembly (46).

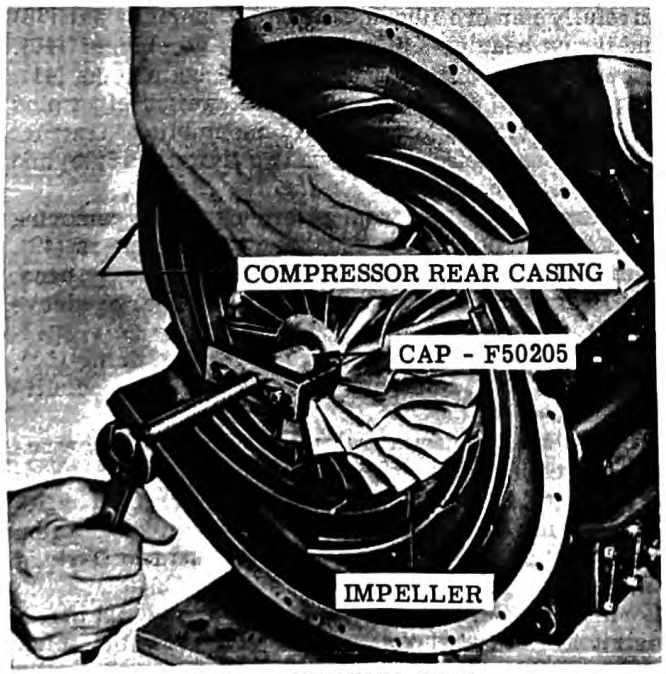


FIGURE 4-11. REMOVING IMPELLER FROM WHEEL AND SHAFT ASSEMBLY

m. Remove eight bolts (47) and washers (48) which secure the nozzle box and first-stage heat shield to the rear rotor housing flange. Remove nozzle box (49) and first-stage heat shield (50). Remove pressure tap plug (51) from top boss on nozzle box and remove elbow (52) from bottom boss on nozzle box.

n. Using two fo the six bolts previously removed with the air deflector, jack seal assembly free of the rotor housing by installing and tightening bolts in two diametrically opposite holes in the bearing cap and oil seal assembly. Remove bearing cap and oil seal assembly (53) and gasket (54).

o. Remove lockwire and remove four bolts (55) securing retainer plate, floating bearing and bearing retainer to rear of rotor housing. Remove retainer plate (56), floating bearing (57) and the bearing retainer (58).

p. Working down through the top opening in the rotor housing remove the lockwire and four bolts (59) which secure the retainer plate, floating bearing and bearing retainer to the rotor housing. Remove bearing retainer plate (60), floating bearing (61) and bearing retainer (62).

q. Remove seven nuts (63), one nut (64) and eight washers (65) which secure the rear compressor casing to the rotor housing. Remove the rear compressor casing (66) and shims (67). Remove name plate (68) by removing two screws (69) and washers (70) from the top center of the compressor casing.

r. Working through opening in the top of the rotor housing, disconnect scavenge return tube assembly (71)

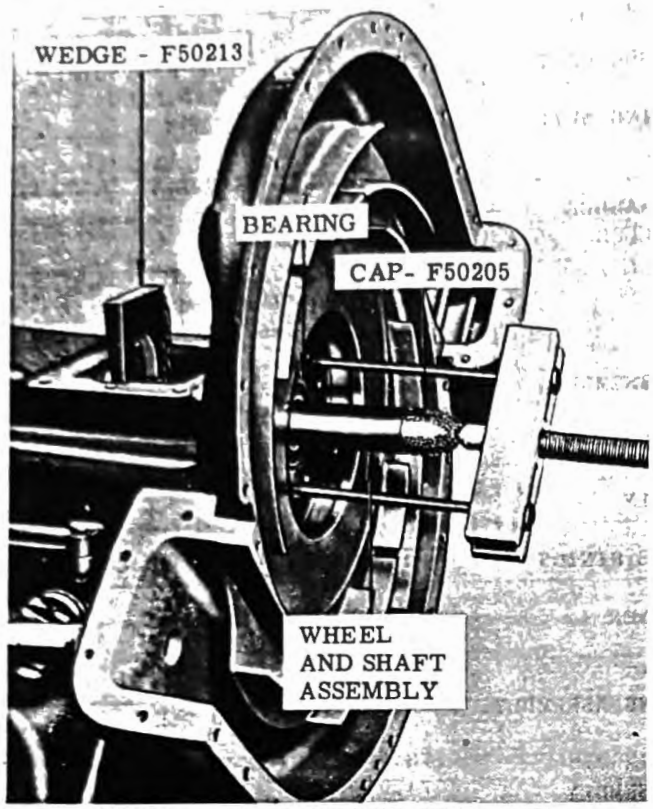


FIGURE 4-12. REMOVING WHEEL AND SHAFT ASSEMBLY

from the inside end of the union threaded through right-hand side of the rotor housing. Remove union (72) from rotor housing (73), and disassemble O-ring (74) from union.

4-38. SUMP AND BASE SECTION.

4-39. SPECIAL TOOLS. No special tools are required for diassembly of the sump and base section.

4-40. REMOVAL. Refer to paragraph 4-25 for removal of the sump and base section.

4-41. DISASSEMBLY. (See figure 4-13.) The sump and base section should be disassembled in the following manner:

a. Remove four bolts (1) and lift off lower heat shield (2), four lock washers (3), four washers (4) and second-stage heat shield (5).

b. Pull out dipstick (6), unscrew dipstick fitting (7) and remove gasket (8) from fitting.

c. Remove controller support bracket (9) by removing three bolts (10), three lock washers (11) and three washers (12).

d. Remove strainer assembly (13) by removing four bolts (14), four lock washers (15) and four washers (16). Remove oil strainer gasket (17) from between strainer and sump and, if installed, remove plug (18) from strainer.

e. Detach manifold bracket (19) by removing bolts (20) and (21), two washers (22), clamp (23) and spacer (24) from oil sump and base assembly (25).

4-42. FUEL PUMP AND GOVERNOR ASSEMBLY.

4-43. SPECIAL TOOLS. No special tools are required for removal or disassembly of the fuel pump and governor assembly.

4-44. REMOVAL. Refer to paragraph 4-11 for removal of the fuel pump and governor assembly.

4-45. DISASSEMBLY. (See figure 4-14.) The fuel pump and governor should be disassembled in the following manner:

a. Remove fuel pump (1) from governor by cutting lockwire and removing four castle nuts (2) and four washers (3). Detach gasket (4) from mounting face of pump.

b. Remove filister head screw (5), washer (6) and slide speed adjusting lever (7) from splines on speed adjusting shaft. Remove filister head screw (8), washer (9) and pull control lever stop (10) from shaft. Remove retaining ring (11). Remove filister head screw (12), lock washer (13), two filister head screws (14), two hex nuts (15) and pull stop ring (16) from cover. Detach cover (17) by removing six filister head screws (18) and six lock washers (19). Remove gasket (20). Remove stop nut (21) and upper speeder spring seat (22). Unscrew speed adjusting shaft and attached parts from cover in direction of speed adjusting lever. Remove speed adjusting worm (23), drive pin (24) and O-ring (25) from speed adjusting shaft (26).

c. To remove rotating parts from governor body, slide drive coupling assembly off exposed end of ballhead shaft and remove spring retainer ring (27), spring drive adapter assembly (28) and torsion drive spring (29) from drive coupling assembly (30). Remove retaining ring (31) and thrust washer (32) from ballhead shaft.

d. Disassemble remaining rotating parts as follows: Remove two filister head screws (33), ballhead cup (34), ballhead cup spacers (35) and speeder spring (36). Lift pilot valve plunger and attached parts from ballhead. Carefully remove fiberlock nut (37), spring seat (38) and thrust bearing (39) from pilot valve plunger (40). From flyweight pivot pins remove four cotter pins (41); four washers (42) and remove two flyweight pivot pins (43) from ballhead and flyweight assemblies. Extract four needle bearings (44) from two flyweights (45) and set aside ballhead (46).

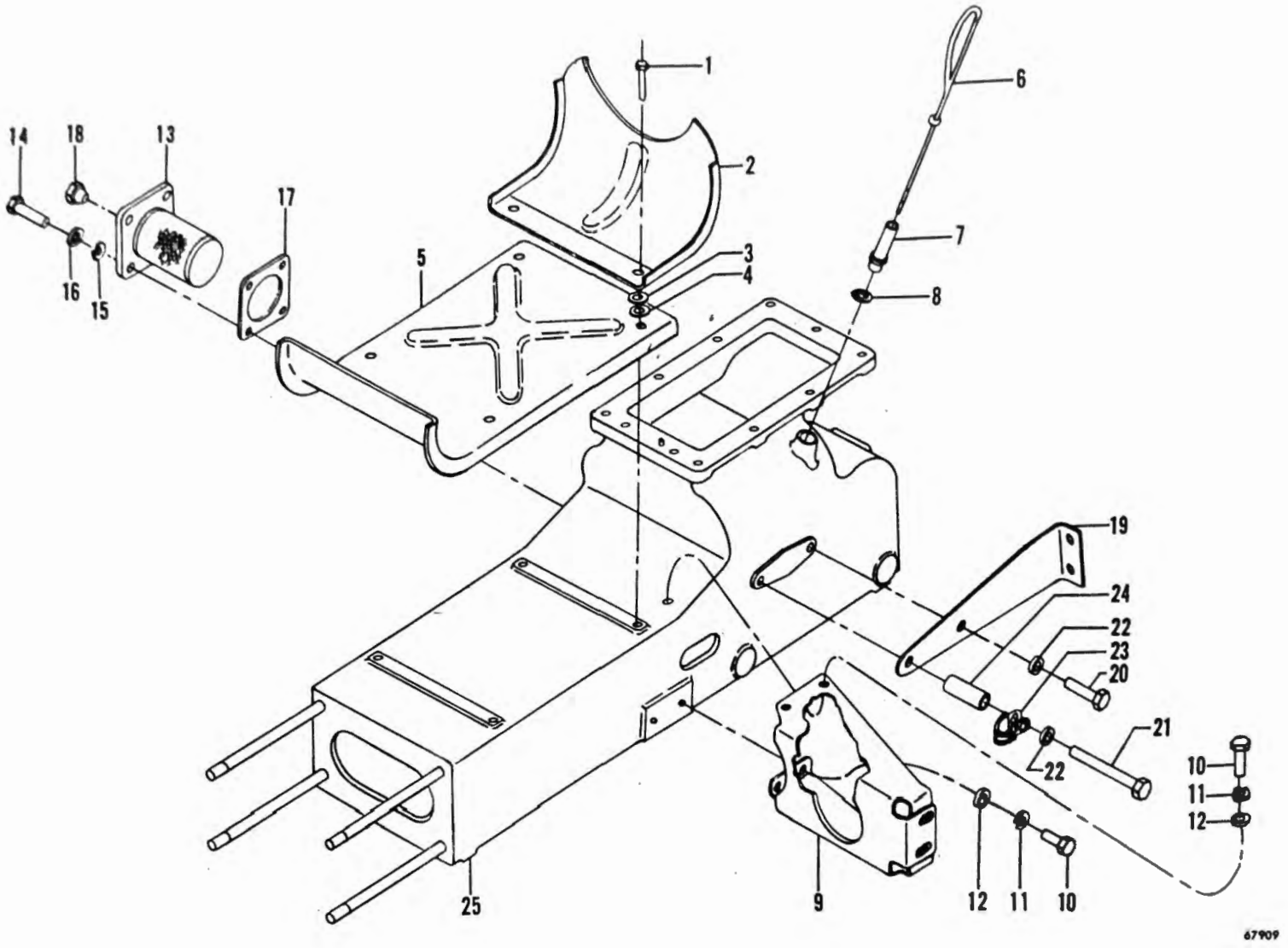
e. Remove base (47) from governor body by removing three filister head screws (48) and three washers (49). Remove seal ring (50) from recess in back side of base.

f. From body remove relief valve discharge sleeve (51) and two O-rings (52).

g. From body remove ultimate valve spring (53), shim washer (54), ultimate valve plunger (55) and ultimate valve seat (56).

h. Remove differential relief valve from body by removing retaining ring (57), relief valve cap (58), O-ring (59), spring guide rod (60), shim washer (61), relief valve spring (62), relief valve piston (63), restriction (64), relief valve sleeve assembly (65) and two O-rings (66).

i. Remove O-ring (67) from face of body and press restriction (68) into body until it falls out of relief valve cavity.



1. BOLT
2. LOWER HEAT SHIELD
3. WASHER
4. WASHER
5. SECOND-STAGE HEAT SHIELD
6. DIP STICK
7. DIP STICK FITTING
8. GASKET
9. CONTROLLER SUPPORT BRACKET
10. BOLT
11. WASHER
12. WASHER
13. STRAINER ASSEMBLY
14. BOLT
15. WASHER
16. WASHER
17. OIL STRAINER GASKET
18. PLUG
19. MANIFOLD BRACKET
20. BOLT
21. BOLT
22. WASHER
23. CLAMP
24. SPACER
25. OIL SUMP AND BASE ASSEMBLY

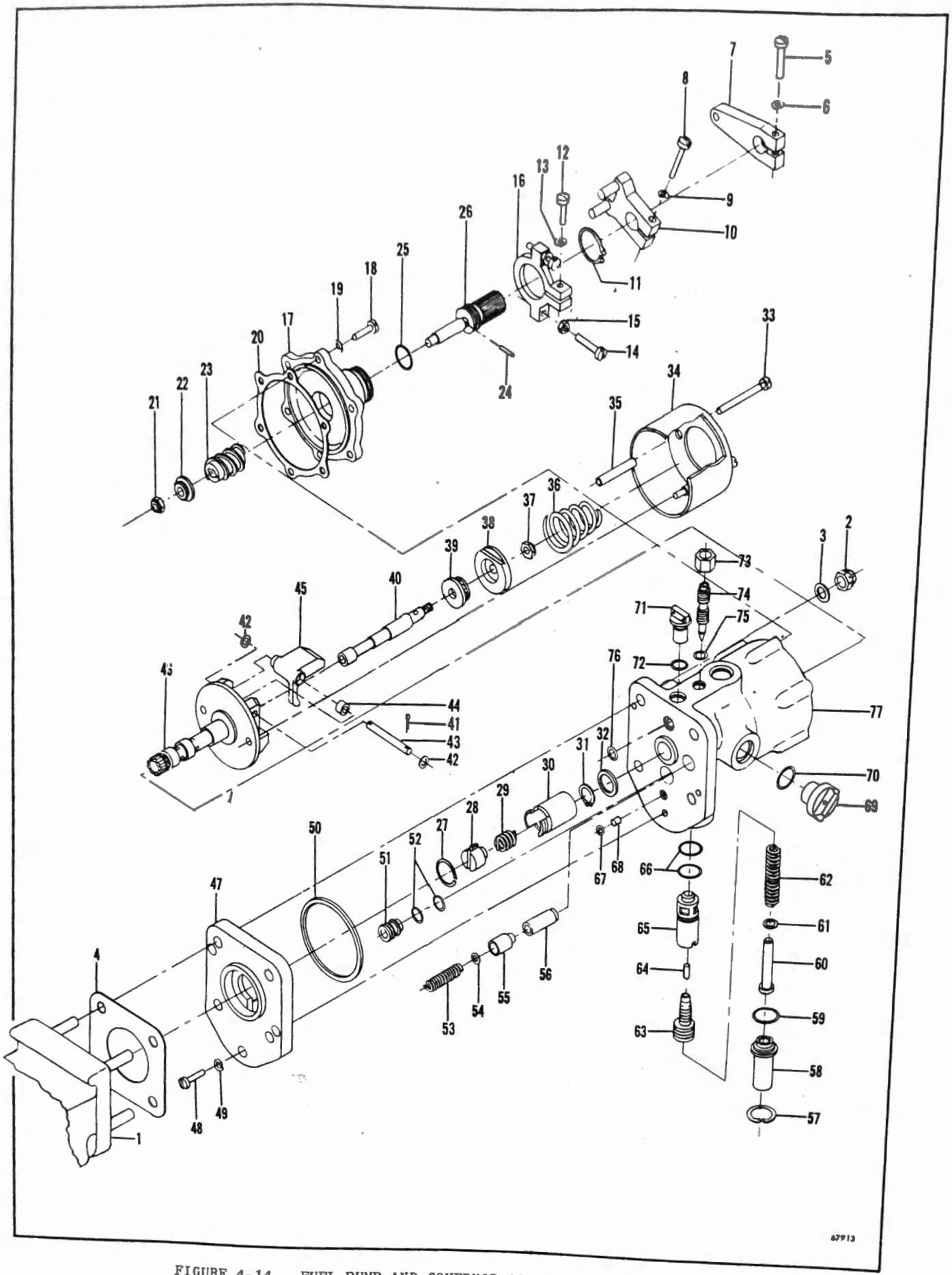


FIGURE 4-14. FUEL PUMP AND GOVERNOR ASSEMBLY (Sheet 1 of 3)

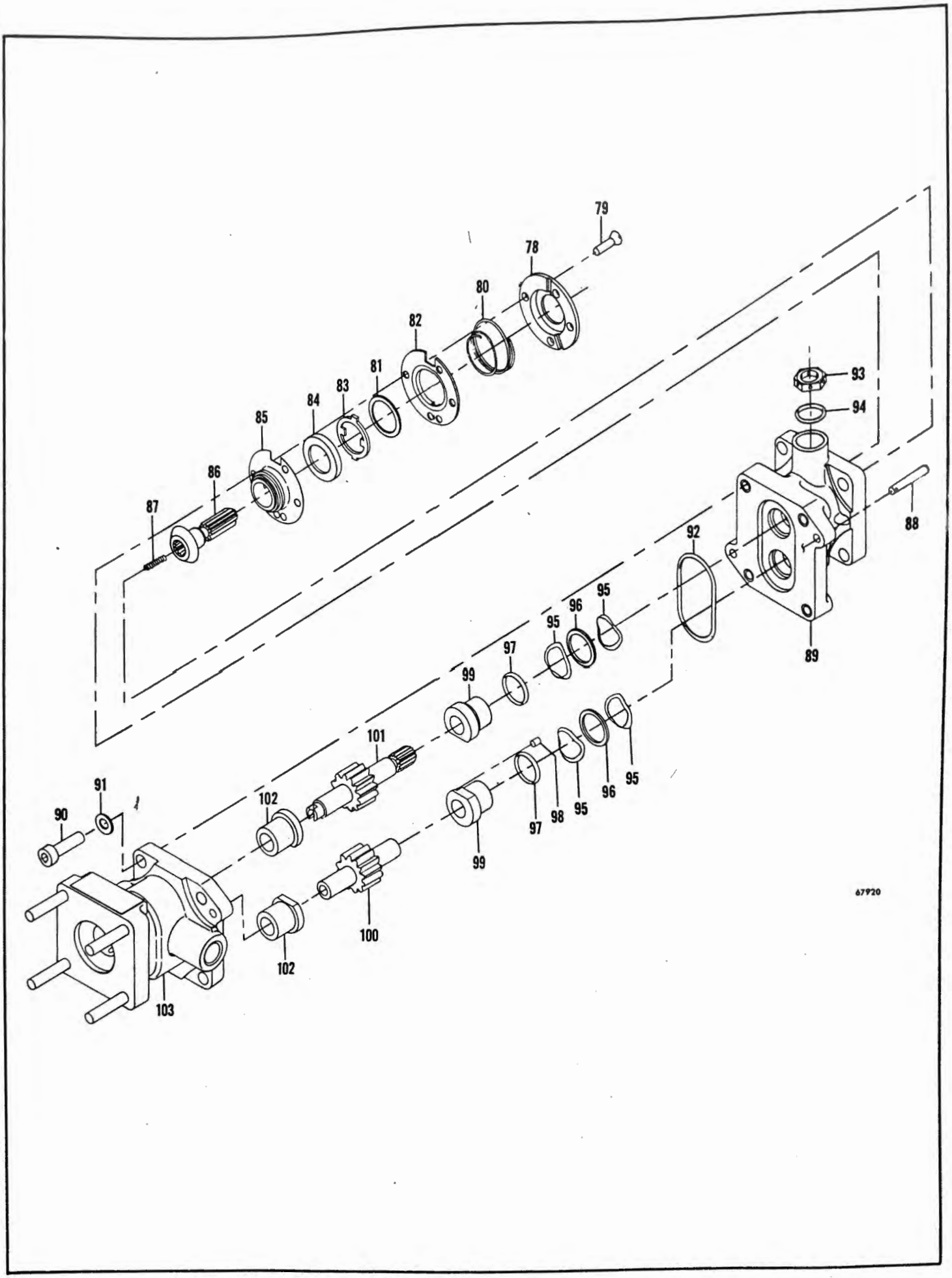


FIGURE 4-14. FUEL PUMP AND GOVERNOR ASSEMBLY (Sheet 2 of 3)

KEY TO FIGURE 4-14.

1. FUEL PUMP
2. CASTLE NUT
3. WASHER
4. GASKET
5. SCREW
6. WASHER
7. SPEED ADJUSTING LEVER
8. SCREW
9. WASHER
10. CONTROL LEVER STOP
11. RETAINING RING
12. SCREW
13. WASHER
14. SCREW
15. NUT
16. STOP RING
17. COVER
18. SCREW
19. WASHER
20. COVER GASKET
21. NUT
22. UPPER SPEEDER SPRING SEAT
23. SPEED ADJUSTING WORM
24. DRIVE PIN
25. O-RING
26. SPEED ADJUSTING SHAFT
27. SPRING RETAINER RING
28. SPRING DRIVE ADAPTER ASSEMBLY
29. TORSION DRIVE SPRING
30. DRIVE COUPLING ASSEMBLY
31. RETAINING RING
32. THRUST WASHER
33. SCREW
34. BALLHEAD CUP
35. BALLHEAD CUP SPACER
36. SPEEDER SPRING
37. NUT
38. SPRING SEAT
39. THRUST BEARING
40. PILOT VALVE PLUNGER
41. PIN
42. WASHER
43. FLYWEIGHT PIVOT PIN
44. NEEDLE BEARING
45. FLYWEIGHT
46. BALLHEAD
47. BASE
48. SCREW
49. WASHER
50. SEAL RING
51. RELIEF VALVE DISCHARGE SLEEVE
52. O-RING
53. ULTIMATE VALVE SPRING
54. SHIM WASHER
55. ULTIMATE VALVE PLUNGER
56. ULTIMATE VALVE SEAT
57. RETAINING RING
58. RELIEF VALVE CAP
59. O-RING
60. SPRING GUIDE ROD
61. SHIM WASHER
62. RELIEF VALVE SPRING
63. RELIEF VALVE PISTON
64. RESTRICTION
65. RELIEF VALVE SLEEVE ASSEMBLY
66. O-RING
67. O-RING
68. RESTRICTION
69. PLUG
70. O-RING
71. CHECK VALVE PLUG
72. O-RING
73. LOCK NUT
74. NEEDLE VALVE
75. O-RING
76. O-RING
77. BODY
78. THRUST PLATE
79. SCREW
80. SPRING
81. WASHER
82. STOP
83. WASHER
84. DIAPHRAGM GUIDE
85. DIAPHRAGM ASSEMBLY
86. COUPLING
87. SPRING
88. TAPER PIN
89. COVER
90. SOCKET HEAD SCREW
91. WASHER
92. SEAL RING
93. PLUG
94. GASKET
95. SPRING
96. SPRING SPACER
97. SEAL RING
98. SEAL PIN
99. COVER BEARING
100. DRIVEN GEAR
101. DRIVE GEAR
102. BODY BEARING
103. BODY ASSEMBLY

FIGURE 4-14. FUEL PUMP AND GOVERNOR ASSEMBLY (Sheet 3 of 3)

j. From side of body remove plug (69) and O-ring (70).

k. From top of body remove check valves plug (71) and O-ring (72).

l. From top of body remove lock nut (73), needle valve (74) and O-ring (75).

m. Remove O-ring (76) from face of body (77).

n. (See figure 4-14, sheet 2.) Disassemble the fuel pump by removing the thrust plate (78) from splined end of body assembly by removing four screws (79). Remove spring (80), washer (81), stop (82), washer (83), diaphragm guide (84) and diaphragm assembly (85) from coupling (86). Pull spring (87) from end of drive gear. Drive two taper pins (88) from body assembly and cover (89) from body assembly by removing four socket head screws (90) and four washers (91) before lifting off cover, stand pump on its mounting studs.

o. From cover inner face extract seal ring (92). On top drain boss of cover, cut lockwire and remove plug (93) and gasket (94).

p. Lift four wafer springs (95) and two spring spacers (96) from top of two cover bearings. Roll two seal rings (97) off cover bearings and carefully remove seal pin (98) from between cover bearings (99) by lifting bearings off gear shafts. Lift driven gear (100) and drive gear (101) from body bearings.

q. Grasp body assembly in hand and shake two body bearings (102) from their seats by tapping body assembly (103) lightly against flat, solid surface.

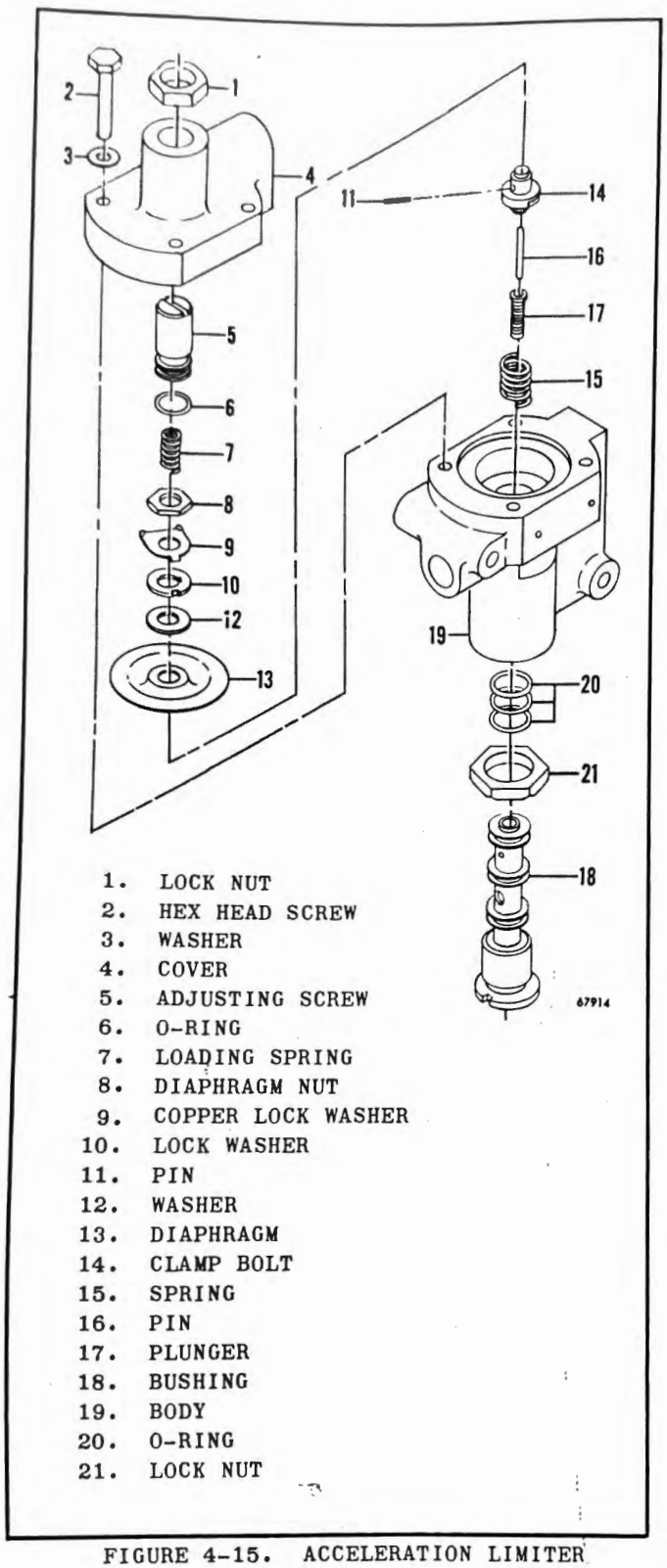
4-46. ACCELERATION LIMITER

4-47. SPECIAL TOOLS. No special tools are required for removal or disassembly of acceleration limiter.

4-48. REMOVAL. Refer to paragraph 4-11 for removal of acceleration limiter.

4-49. DISASSEMBLY. (See figure 4-15.) The acceleration limiter should be disassembled in the following manner:

a. Detach cover from body by removing lock nut (1), four hex head screws (2) and four washers (3). Hold cover (4) and turn adjusting screw (5) downward and remove O-ring (6) from adjusting screw. From clamp



1. LOCK NUT
2. HEX HEAD SCREW
3. WASHER
4. COVER
5. ADJUSTING SCREW
6. O-RING
7. LOADING SPRING
8. DIAPHRAGM NUT
9. COPPER LOCK WASHER
10. LOCK WASHER
11. PIN
12. WASHER
13. DIAPHRAGM
14. CLAMP BOLT
15. SPRING
16. PIN
17. PLUNGER
18. BUSHING
19. BODY
20. O-RING
21. LOCK NUT

FIGURE 4-15. ACCELERATION LIMITER

bolt remove loading spring (7), diaphragm nut (8), copper lock washer (9) and lock washer (10). Drive pin (11) from clamp bolt and lift off washer (12) and diaphragm (13). Lift out clamp bolt (14) and spring (15). Extract pin (16) from plunger and pull plunger (17) from bushing. Loosen nut, unscrew bushing (18) from body (19) and remove three O-rings (20) and lock nut (21) from bushing.

4-50. HIGH PRESSURE FUEL FILTER.

4-51. SPECIAL TOOLS. No special tools are required for removal or disassembly of the high pressure fuel filter.

4-52. REMOVAL. Refer to paragraph 4-11 for removal of high pressure fuel filter.

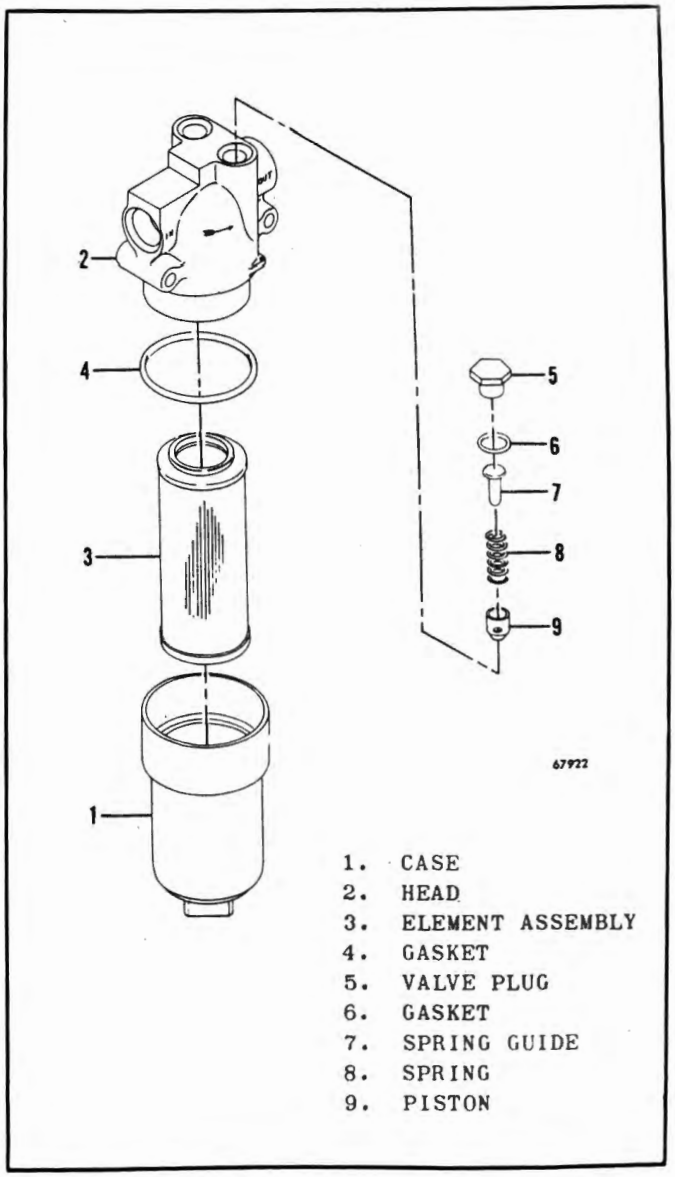
4-53. DISASSEMBLY. (See figure 4-16.) The high pressure fuel filter should be disassembled in the following manner:

a. Place square boss on bottom of case (1) in vise, cut and remove safety wire, and unscrew head (2) from case.

b. Lift element assembly (3) from case. Carefully pry case gasket (4) from underneath retaining ring and remove from case.

c. Cut safety wire and unscrew two valve plugs (5) from head. Remove two plug gaskets (6) from plug.

d. Remove from vise, invert head, and shake out two spring guides (7), two springs (8) and two pistons (9).



1. CASE
2. HEAD
3. ELEMENT ASSEMBLY
4. GASKET
5. VALVE PLUG
6. GASKET
7. SPRING GUIDE
8. SPRING
9. PISTON

FIGURE 4-16. HIGH PRESSURE FUEL FILTER

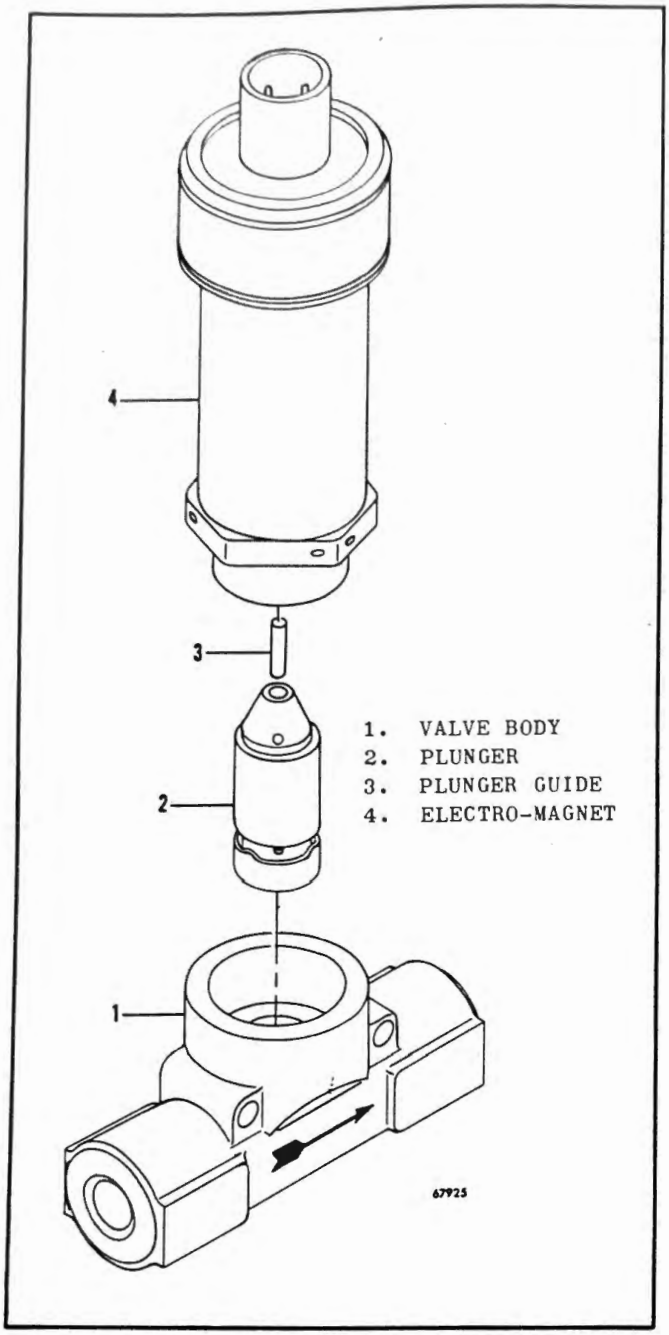


FIGURE 4-17. FUEL SOLENOID

4-54. FUEL SOLENOID.

4-55. SPECIAL TOOLS. No special tools are required for removal or disassembly of fuel solenoid.

4-56. REMOVAL. Refer to paragraph 4-11 for removal of fuel solenoid.

4-57. DISASSEMBLY. (See figure 4-17.) The fuel solenoid should be disassembled in the following manner:

a. Unscrew valve body (1) from electromagnet. Shake plunger (2) and plunger guide (3) from electromagnet (4).

4-58. LUBE AND SCAVENGE PUMP.

4-59. SPECIAL TOOLS. No special tools are required for removal and disassembly of the lube and scavenge pump.

4-60. REMOVAL. Refer to paragraph 4-14 for removal of lube and scavenge pump.

4-61. DISASSEMBLY. (See figure 4-18.) The lube and scavenge pump should be disassembled in the following manner:

a. Remove filister head machine screw (1) from pump body. Secure lube pump in vise and, using two drift punches with screw driver wedged between them, remove lock nut (2). Slip O-ring (3) off lock nut. From drive coupling remove retaining ring (4) and drive seal coupling (5). Remove O-ring (6) from seal plate and remove seal plate (7), seal disc (8) and O-ring (9) from inside lock nut. Extract drive coupling (10) from lock nut. From inside top of body remove seal spring (11), spring seat (12) and front bearing (13). Remove upper rotor from upper liner and pull four blades (14) from rotor (15). Remove two set screws (16) and two Lockoseals (17) from rear of body. Slide liner (18) up and out of body. Lift center drive coupling (19) from lower rotor and remove retaining ring (20) from coupling. Remove center bearing (21) from body. Remove lower rotor from lower liner and pull four blades (22) from rotor (23). From body remove liner (24) and rear bearing (25). Unscrew valve cap assembly (26) from body. From cap remove spring guide (27), gasket (28) and adjusting screw (29). Remove relief valve spring (30) and relief valve (31) from body assembly (32).

4-62. OIL PRESSURE SWITCH.

4-63. SPECIAL TOOLS. No special tools are required for removal or disassembly of the oil pressure switch.

4-64. REMOVAL. (For removal refer to paragraph 4-14.)

4-65. DISASSEMBLY. (See figure 4-19.) The oil ■ pressure switch should be disassembled in the following manner:

a. Remove lock nut (1), and unscrew adjustment sleeve (2) from body; this will free adjustment spring (3) and spring seat (4).

b. Remove two screws (5) which will release mounting bracket (6) for removal.

c. Remove three nuts (7), washers (8), nuts (9), washers (10), and insulator washers (11) from bolt which secures internal wiring to body (12). Remove three internal insulators (13) by withdrawing three square shouldered bolts (14). This will free three internal wires (15).

d. Remove two screws (16) and two washers (17) to free microswitch (18) from top plate. Remove pressure peg (19) from top plate.

e. Remove six bolts (20) which hold base (21), two diaphragms (22), actuator (23) to top plate (24).

1. SCREW
2. LOCK NUT
3. O-RING
4. RETAINING RING
5. DRIVE SEAL COUPLING
6. O-RING
7. SEAL PLATE
8. SEAL DISC
9. O-RING
10. DRIVE COUPLING
11. SEAL SPRING
12. SPRING SEAT
13. BEARING
14. BLADE
15. ROTOR
16. FILISTER HEAD MACHINE SCREW
17. LOCK-O-SEAL
18. LINER
19. CENTER DRIVE COUPLING
20. RETAINING RING
21. CENTER BEARING
22. BLADE
23. ROTOR
24. LINER
25. BEARING
26. VALVE CAP ASSEMBLY
27. SPRING GUIDE
28. GASKET
29. ADJUSTING SCREW
30. RELIEF VALVE SPRING
31. RELIEF VALVE
32. BODY ASSEMBLY

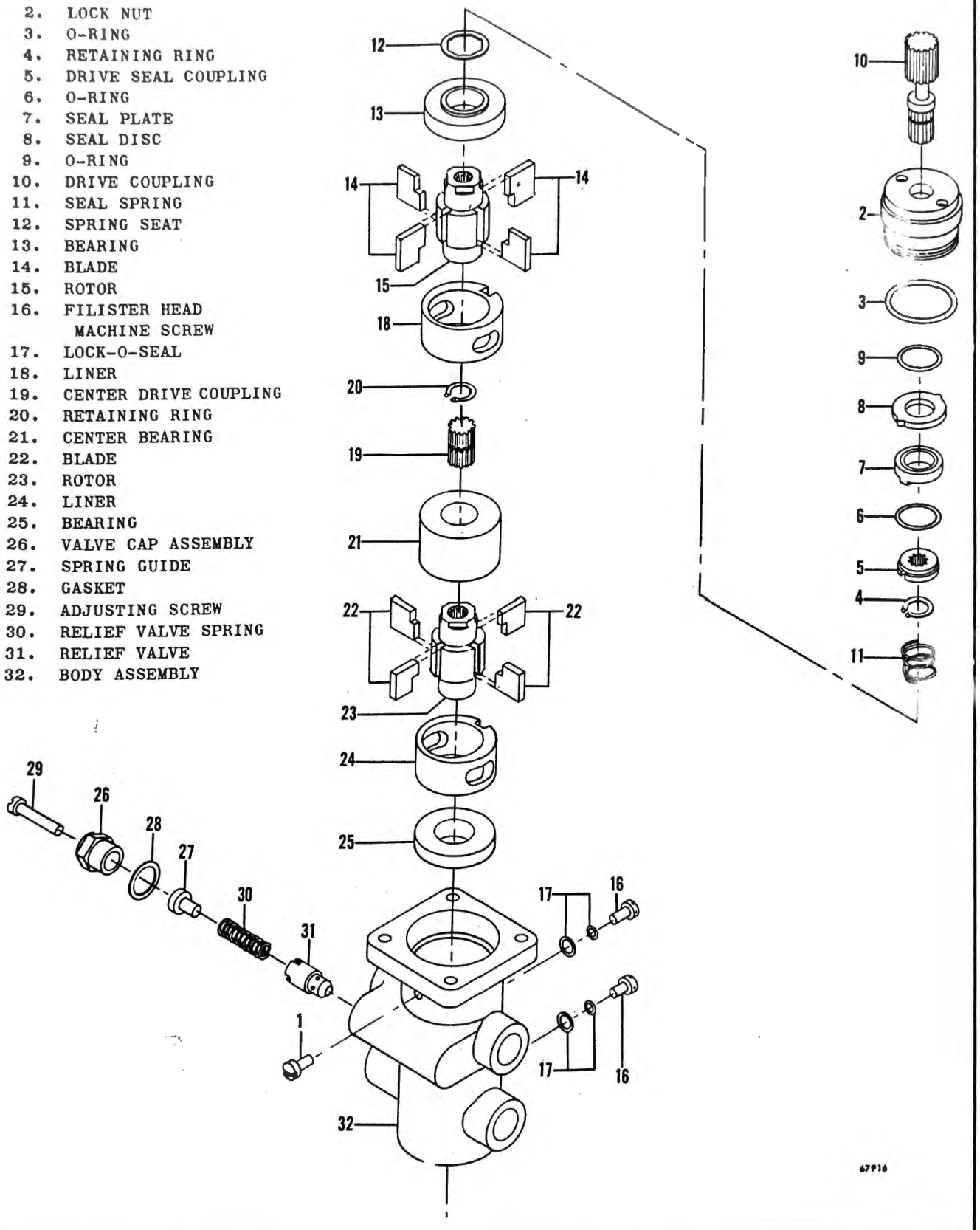
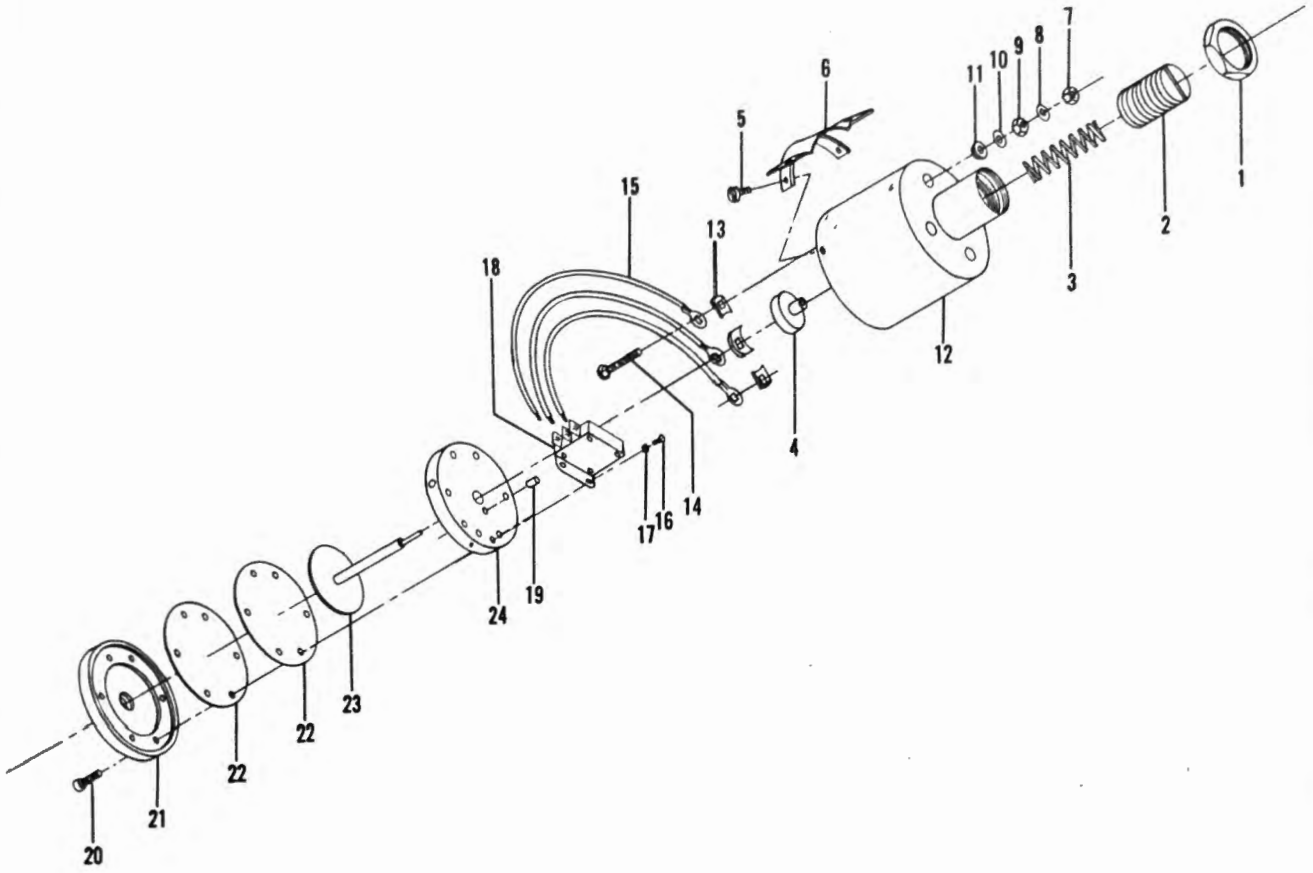


FIGURE 4-18. LUBE AND SCAVENGE PUMP



1. LOCK NUT
2. ADJUSTMENT SLEEVE
3. ADJUSTMENT SPRING
4. SPRING SEAT
5. SCREW
6. MOUNTING BRACKET
7. NUT
8. WASHER
9. NUT
10. WASHER
11. INSULATOR WASHER
12. BODY
13. INSULATOR
14. BOLT
15. TERMINAL WIRE
16. BOLT
17. WASHER
18. SWITCH
19. PRESSURE PEG
20. BOLT
21. BASE
22. DIAPHRAGM
23. ACTUATOR
24. TOP PLATE

FIGURE 4-19. OIL PRESSURE SWITCH

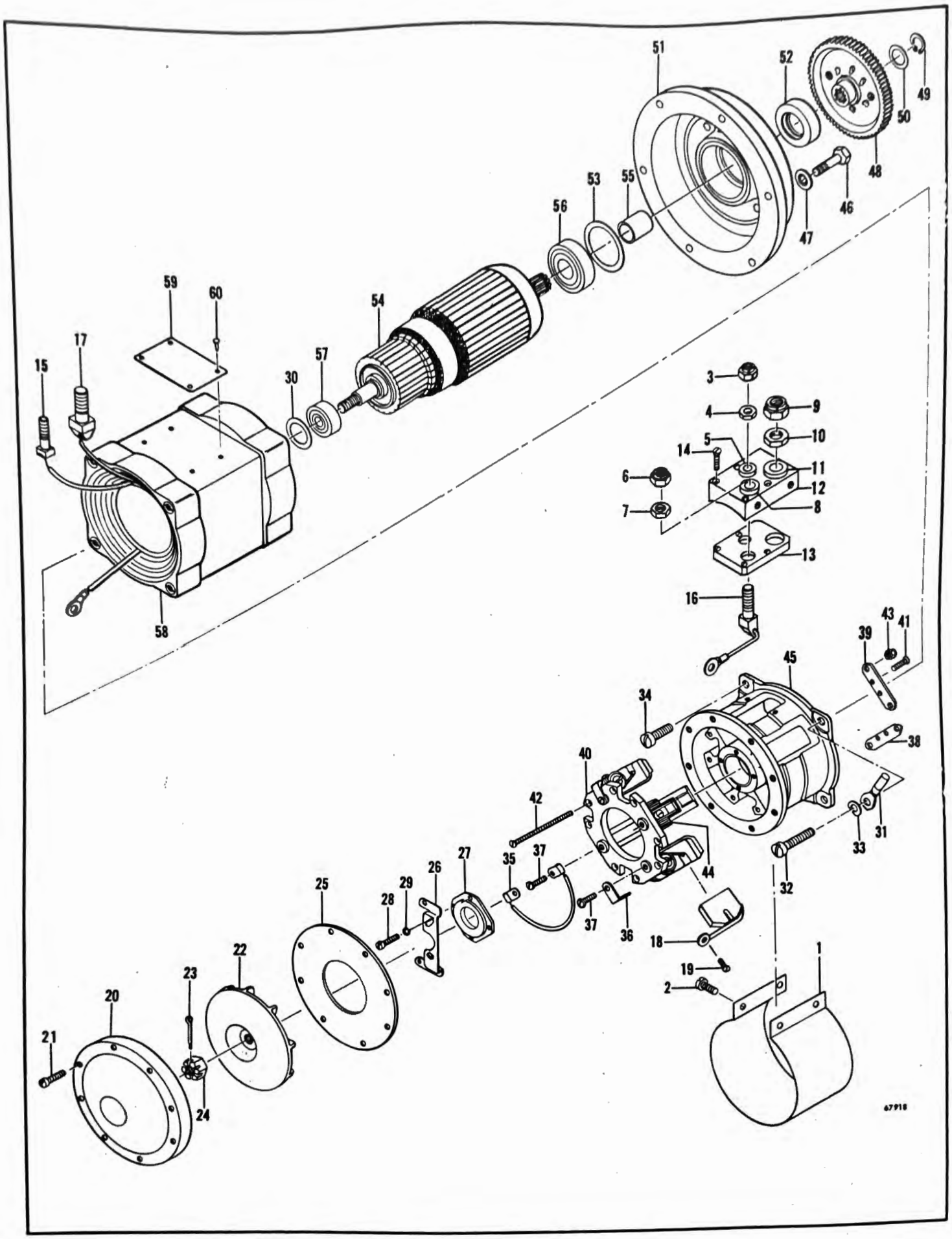


FIGURE 4-20. STARTER-GENERATOR (Sheet 1 of 2)

KEY TO FIGURE 4-20.

1. SIDE COVER
2. SCREW
3. NUT
4. CHECK NUT
5. INSULATOR
6. NUT
7. CHECK NUT
8. INSULATOR
9. NUT
10. CHECK NUT
11. INSULATOR
12. TERMINAL BASE
13. BASE INSERT
14. SCREW
15. TERMINAL STUD
16. TERMINAL STUD
17. TERMINAL STUD
18. BRUSH
19. SCREW
20. FAN COVER
21. SCREW
22. FAN
23. PIN
24. NUT
25. AIR DEFLECTOR PLATE
26. GROUND STRAP
27. BEARING RETAINER
28. SCREW
29. WASHER
30. SHIM
31. TERMINAL LUG
32. SCREW
33. WASHER
34. SCREW
35. WIRE LEAD
36. TERMINAL STRAP
37. SCREW
38. FRONT CONDUCTING SEGMENT
39. FRONT INSULATING SEGMENT
40. BRUSH HOLDER ASSEMBLY
41. SCREW
42. SCREW
43. NUT
44. BRUSH SPRING
45. END BELL
46. BOLT
47. LOCK-O-SEAL
48. GEAR
49. RETAINING RING
50. SHIM
51. END PLATE
52. OIL SEAL
53. SHIM
54. ROTOR ASSEMBLY
55. SHAFT SLEEVE
56. BALL BEARING
57. BALL BEARING
58. STATOR ASSEMBLY
59. NAMEPLATE
60. SCREW

FIGURE 4-20. STARTER-GENERATOR (Sheet 2 of 2)

4-66. STARTER-GENERATOR.

4-67. SPECIAL TOOLS. No special tools are required for removal or disassembly of the starter-generator.

4-68. REMOVAL. Refer to paragraph 4-25 for removal of starter-generator.

4-69. DISASSEMBLY. (See figure 4-20.) The starter-generator should be disassembled in the following manner:

NOTE

Except where stated otherwise, disassemble in the order of the index numbers assigned to figure 4-20. Never disassemble any more of the starter-generator than is necessary to make required inspections and repairs.

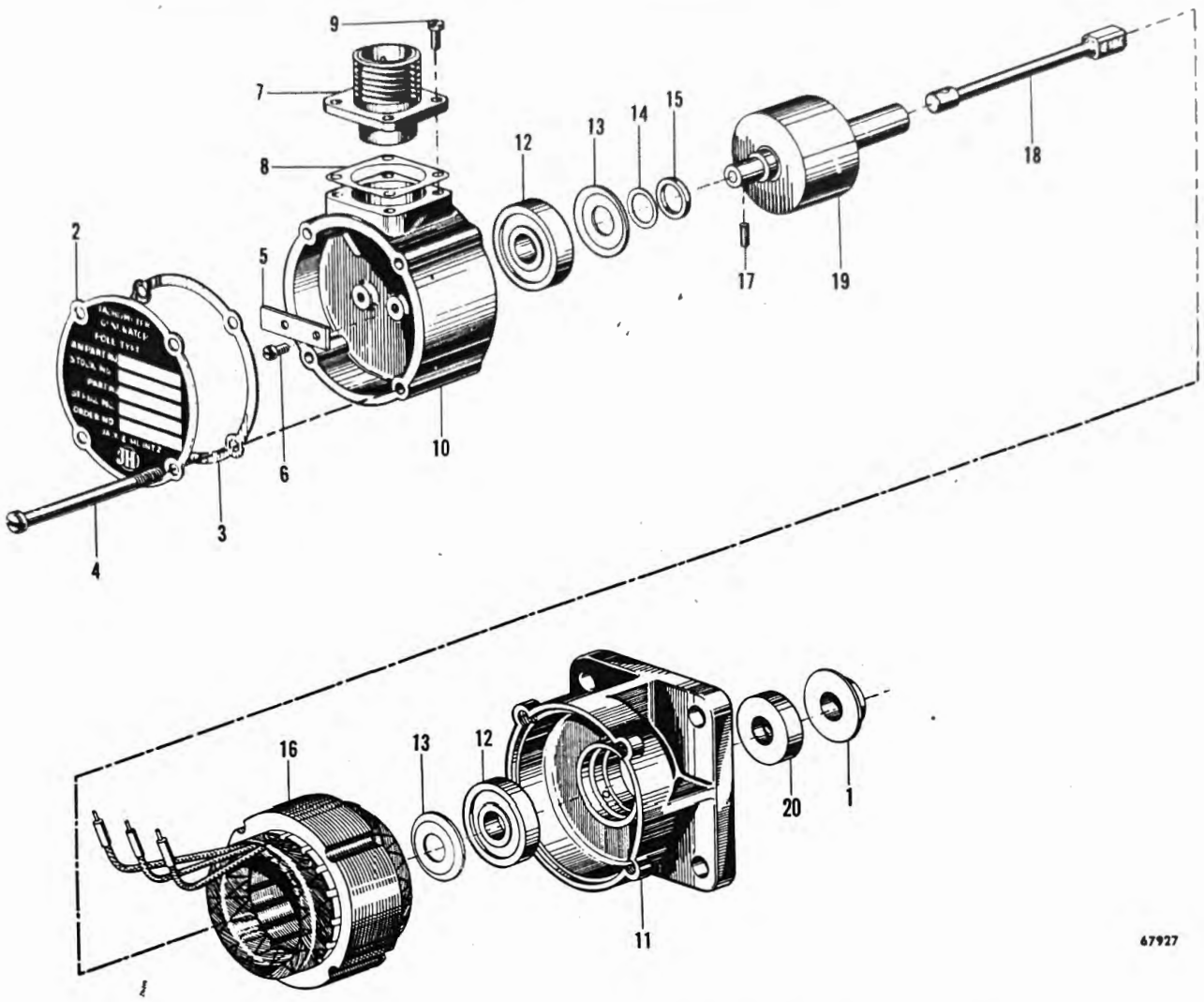
a. Remove side cover (1). Remove brushes (18).
b. Remove nuts (3), (4), (6), (7), (9) and (10), and insulators (5), (8) and (11). Remove terminal base (12), and base insert (13).
c. Do not remove terminal studs (15) and (17) except to replace them. If necessary, unsolder the studs from their wire leads. Terminal stud (16) is removed when the end bell assembly is disassembled.
d. Remove fan cover (20), fan (22) and air deflector plate (25).
e. Remove ground strap (26) and bearing retainer (27). Remove wire lead (35). Disconnect terminal stud (16) and stator lead from the brush boxes. Remove end bell assembly.
f. Remove front conducting segment (38), front insulating segment (39) and brush holder assembly (40). Remove brush springs (44).
g. Remove complete rotor assembly (48 through 57) from stator assembly (58). Remove gear (48) and end plate (51). Remove oil seal (52). Remove shaft sleeve (55) and ball bearings (56) and (57).

4-70. TACHOMETER GENERATOR.

4-71. SPECIAL TOOLS. No special tools are required for removal or disassembly of tachometer generator.

4-72. REMOVAL. Refer to paragraph 4-25 for removal of tachometer generator.

4-73. DISASSEMBLY. (See figure 4-21.) The tachometer generator should be disassembled in the following manner:
a. Begin disassembly of tachometer generator by removing slinger (1) from drive shaft at front of generator.
b. Remove nameplate (2) and gasket (3) from end bell by withdrawing four long screws (4). Detach lead clamp (5) from inside end bell, by removing two screws (6). When disassembling lead clamp, do not unsolder lead connection from stator to lead clamp unless either the "C" lead (blue wire), clamp or stator needs to be replaced.
c. Disassemble receptacle (7) and gasket (8) from end bell by removing four screws (9) from rear end bell (10). Do not unsolder leads "B" and "A" (yellow and red) unless it is necessary to replace the receptacle, stator or either of the leads "B" and "A".
d. Detach front end bell (11) and the parts attached to it from the rear end bell and lift out the rotor and stator group.
e. Using a bearing puller, carefully remove inner races and ball cages of two ball bearings (12) from rotor shaft. Remove bearing retainer (13), shim (14), and washer (15) from rotor shaft.
f. Pull rotor assembly out of stator (16).



1. SLINGER
2. NAMEPLATE
3. GASKET
4. SCREW
5. CLAMP
6. SCREW
7. RECEPTACLE
8. GASKET
9. SCREW
10. REAR END BELL ASSEMBLY
11. END BELL ASSEMBLY
12. BALL BEARING
13. BEARING RETAINER
14. SHIM
15. WASHER
16. STATOR ASSEMBLY
17. PIN
18. DRIVE SHAFT
19. ROTOR SUBASSEMBLY
20. OIL SEAL

FIGURE 4-21. TACHOMETER GENERATOR

CAUTION

The rotor has a strong magnetic pull and care should be used not to damage the bearing surfaces. When disassembled, the rotor should be located where it will not pick up metal chips, filings or similar foreign materials.

Drive pin (17) out of rotor shaft, and remove drive shaft (18) from rotor (19).

g. Remove oil seal (20) from front end bell.

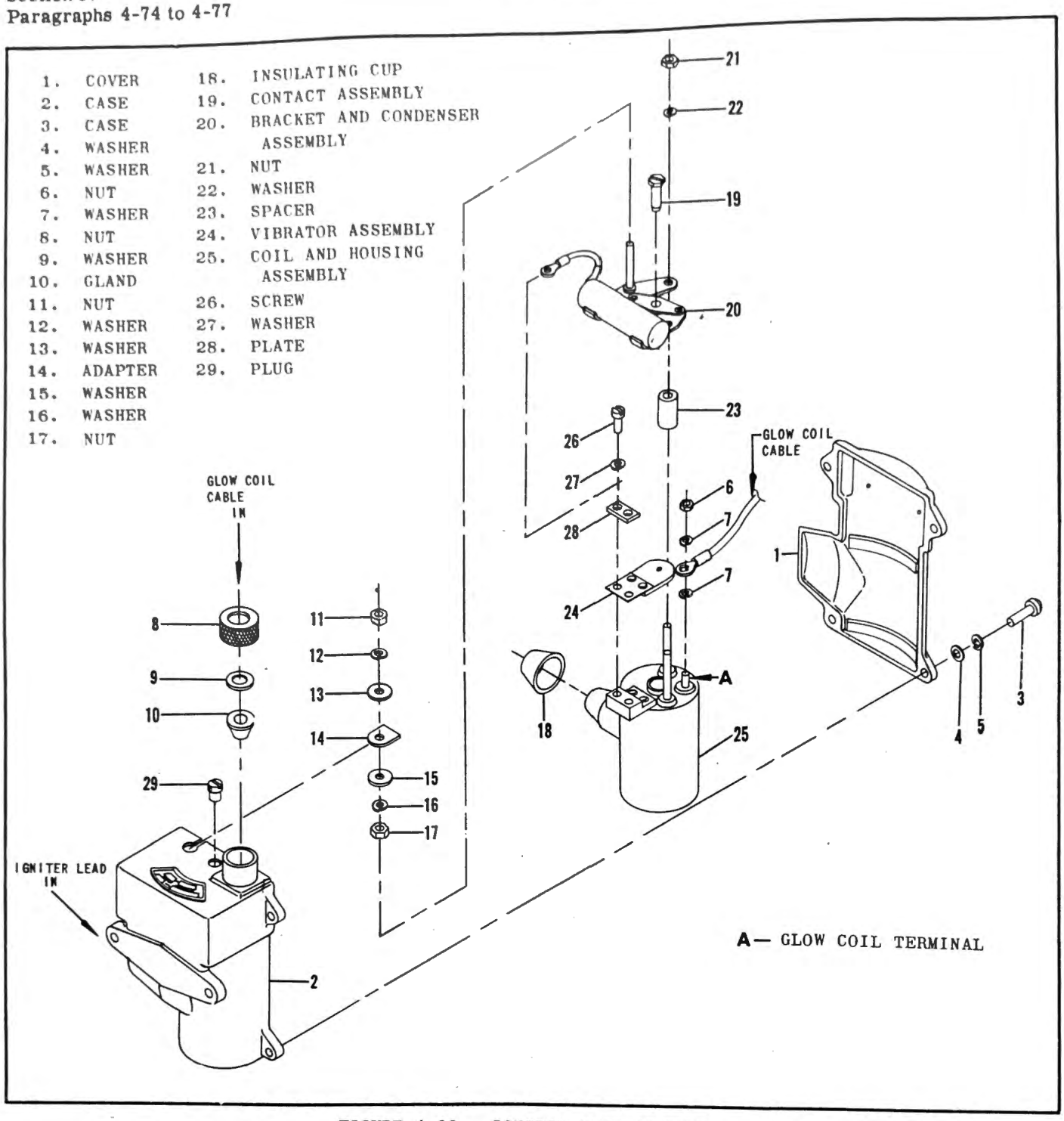


FIGURE 4-22. IGNITER COIL ASSEMBLY

4-74. IGNITER COIL ASSEMBLY.

4-75. SPECIAL TOOLS. No special tools are required for removal or disassembly of igniter coil assembly.

4-76. REMOVAL. Refer to paragraph 4-37 for removal of igniter coil assembly.

4-77. DISASSEMBLY. (See figure 4-22.) The igniter coil assembly should be disassembled in the following manner:

a. Remove cover (1) from case (2) by removing four screws (3), four washers (4) and four washers (5).

b. Remove nut (6) and lock washers (7) from coil and housing assembly terminal to which glow coil cable assembly is attached.

c. Unscrew knurled nut (8) through which igniter lead assembly passes, and remove washer (9) and gland (10) from case, and remove cable.

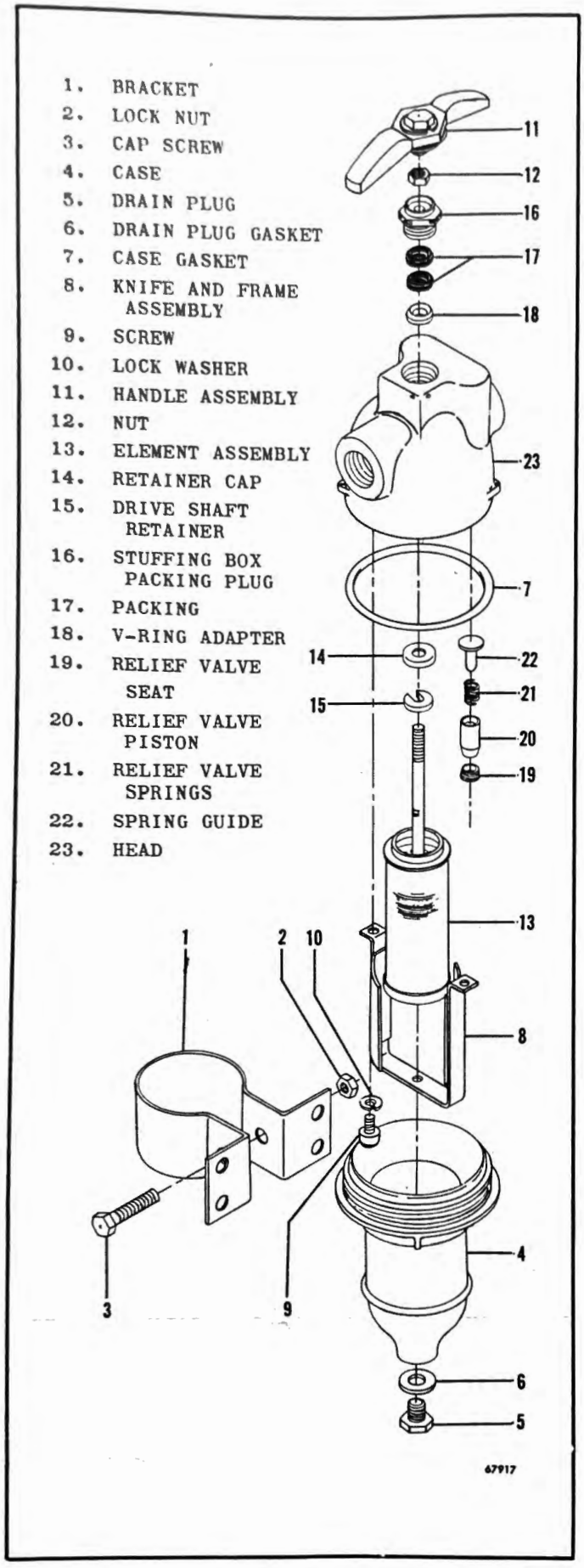


FIGURE 4-23. LOW PRESSURE FUEL FILTER

d. From terminal post on bracket and condenser assembly, remove nut (11), washer (12), washer (13) and adapter (14). Pull bracket and condenser assembly and attached parts from case and remove washer (15), washer (16) and nut (17). Pull insulating cap (18) from coil assembly.

e. Unscrew contact assembly (19) and remove bracket and condenser assembly (20) by removing nut (21) and lock washers (22). Lift four spacers (23) from post on top of coil assembly.

f. Remove vibrator assembly (24) from coil assembly (25) by removing two screws (26), two lock washers (27), and plate (28).

g. Remove plug (29) from top center of case.

4-78. LOW PRESSURE FUEL FILTER.

4-79. SPECIAL TOOLS. No special tools are required for removal or disassembly of the low pressure fuel filter.

4-80. REMOVAL. (See figure 4-1.) Refer to paragraph 4-8 for removal of the low pressure fuel filter.

4-81. DISASSEMBLY. (See figure 4-23.) The low pressure fuel filter should be disassembled in the following manner:

a. Remove bracket (1) from filter case by removing nut (2) and hex head cap screw (3).

b. With filter inverted and secured in vise by top of cleaning handle, unscrew case (4) from head assembly by using wrench on square boss on bottom of case. Remove drain plug (5) from case and slip drain plug gasket (6) from plug. Lift case gasket (7) from its seat inside head.

c. Remove knife and frame assembly (8) from head by removing two screws (9) and two lock washers (10) from underside of head.

NOTE

Removal of the knife and frame assembly will be facilitated by compressing the free ends of the frame with the fingers and wedging out with a screw driver on the outer ends of the knives so as to clear the lip on the end of the filter element.

d. Take filter head from vise and unscrew cleaning handle assembly (11) and nut (12) from top of drive shaft. Pull element assembly (13) out of head and stuffing box packing plug. From the projecting end of drive shaft, slip off retainer cap (14) and pull off drive shaft retainer (15).

e. Unscrew stuffing box packing plug (16) from the head. Carefully hook two packings (17) from inside of head boss and invert head and shake out V-ring adapter (18).

f. Disassemble head assembly by unscrewing two relief valve seats (19) from relief valve housings inside head and remove two relief valve pistons (20), two relief valve springs (21) and two spring guides (22) from head (23).

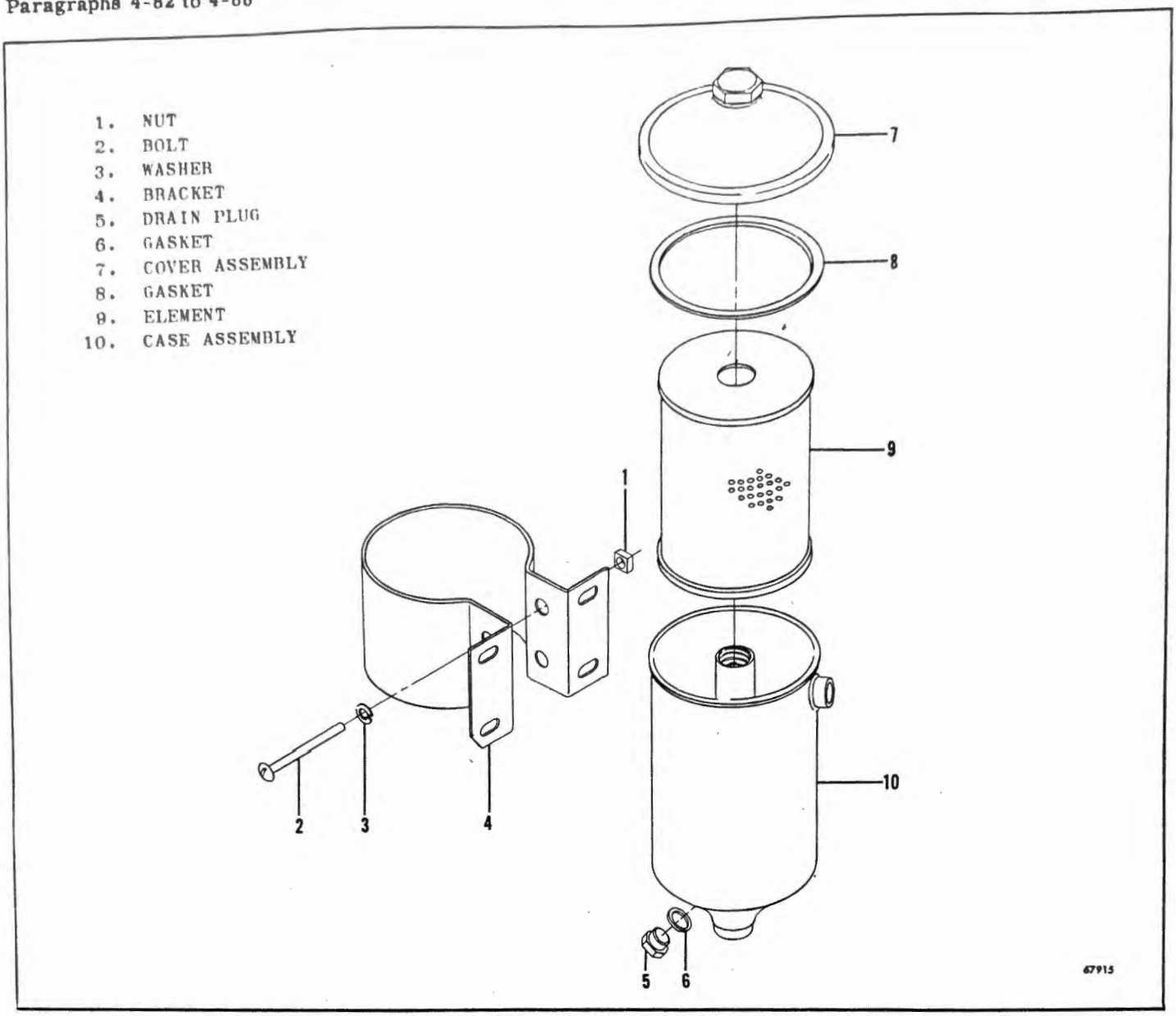


FIGURE 4-24. LUBE FILTER

4-82. LUBE FILTER.

4-83. SPECIAL TOOLS. No special tools are required for removal or disassembly of the lube filter.

4-84. REMOVAL. (See figure 4-1.) Refer to paragraph 4-8 for removal of the lube filter.

4-85. DISASSEMBLY. (See figure 4-24.) The lube filter should be disassembled in the following manner:

a. Remove two nuts (1), two bolts (2) and two washers (3) and slip bracket (4) from case.

b. Unscrew drain plug (5) from case and remove drain plug gasket (6).

c. Unscrew cover assembly (7) from case and remove gasket (8).

d. Lift element assembly (9) out of case assembly (10).

4-86. INLET SILENCER ASSEMBLY.

4-87. SPECIAL TOOLS. No special tools are required for removal or disassembly of the inlet silencer assembly.

4-88. REMOVAL. (See figure 4-1.) Remove inlet silencer assembly in the following manner:

a. Remove 23 screws and 13 washers which secure front panel of turbine end air inlet compartment at front of power package assembly and remove front panel. Loosen eight fasteners and free access panel from air inlet compartment. Remove silencer assembly and panel from air inlet compartment. Remove adapter flange (1, figure 4-25) by removing eight screws (2) which secure flange to silencer assembly and remove silencer assembly from grommet in panel.

NOTE

Reassemble flange and screws to inlet silencer assembly to prevent loss of silencer components.

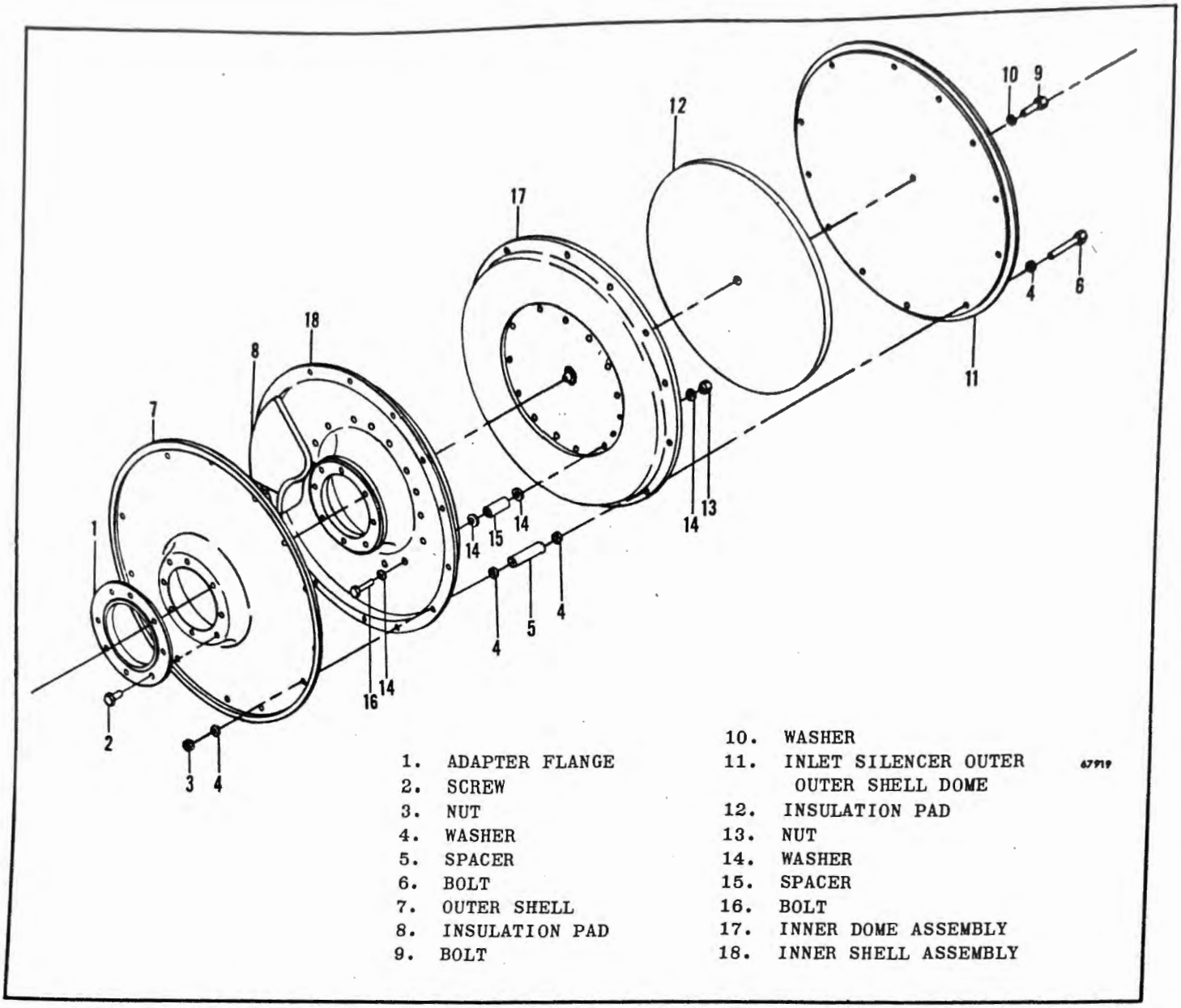


FIGURE 4-25. INLET SILENCER ASSEMBLY

4-89. DISASSEMBLY. (See figure 4-25.) Disassemble the inlet silencer assembly in the following manner:

a. Remove adapter flange (1) by removing eight screws (2).

b. Remove 12 nuts (3), 48 washers (4), 12 spacers (5) and 12 bolts (6). Remove outer shell (7) and insulation pad (8).

c. Remove bolt (9) and washer (10) which secure dome outer shell (11) and insulation pad (12) to inner dome assembly. Separate insulation pad from inner dome assembly.

d. Remove 12 nuts (13), 48 washers (14), 12 spacers (15) and 12 bolts (16) which secure inner shell assembly to inner dome assembly. Separate inner dome assembly (17) from inner shell assembly (18).

4-90. EXHAUST TEMPERATURE PYROMETER.

4-91. SPECIAL TOOLS. No special tools are required for removal or disassembly of exhaust temperature pyrometer.

4-92. REMOVAL. Refer to paragraph 4-8 for removal of exhaust temperature pyrometer.

4-93. DISASSEMBLY. (See figure 4-26.) The exhaust temperature pyrometer should be disassembled in the following manner:

a. Unscrew case cap (1) from case and remove window retainer (2) and window assembly.

b. Disassemble window assembly by removing two screw pins (3) and two washers (4) which secure takeoff adjusting arm (5) and adjusting finger (6) to window (7). Lift gasket (8) from top of case.

c. Unscrew sealing nut (9) and remove instrument mechanism from case (10). Separate cushioning O-ring (11) from mechanism chassis.

d. Detach dial plate (12) from mechanism by removing two dial screws (13) and two washers (14).

e. Movement assembly (15) is removed by removing two nuts (16) and two dial studs (17) and by unsoldering three leads (A, B and C) attached to movement. Un-

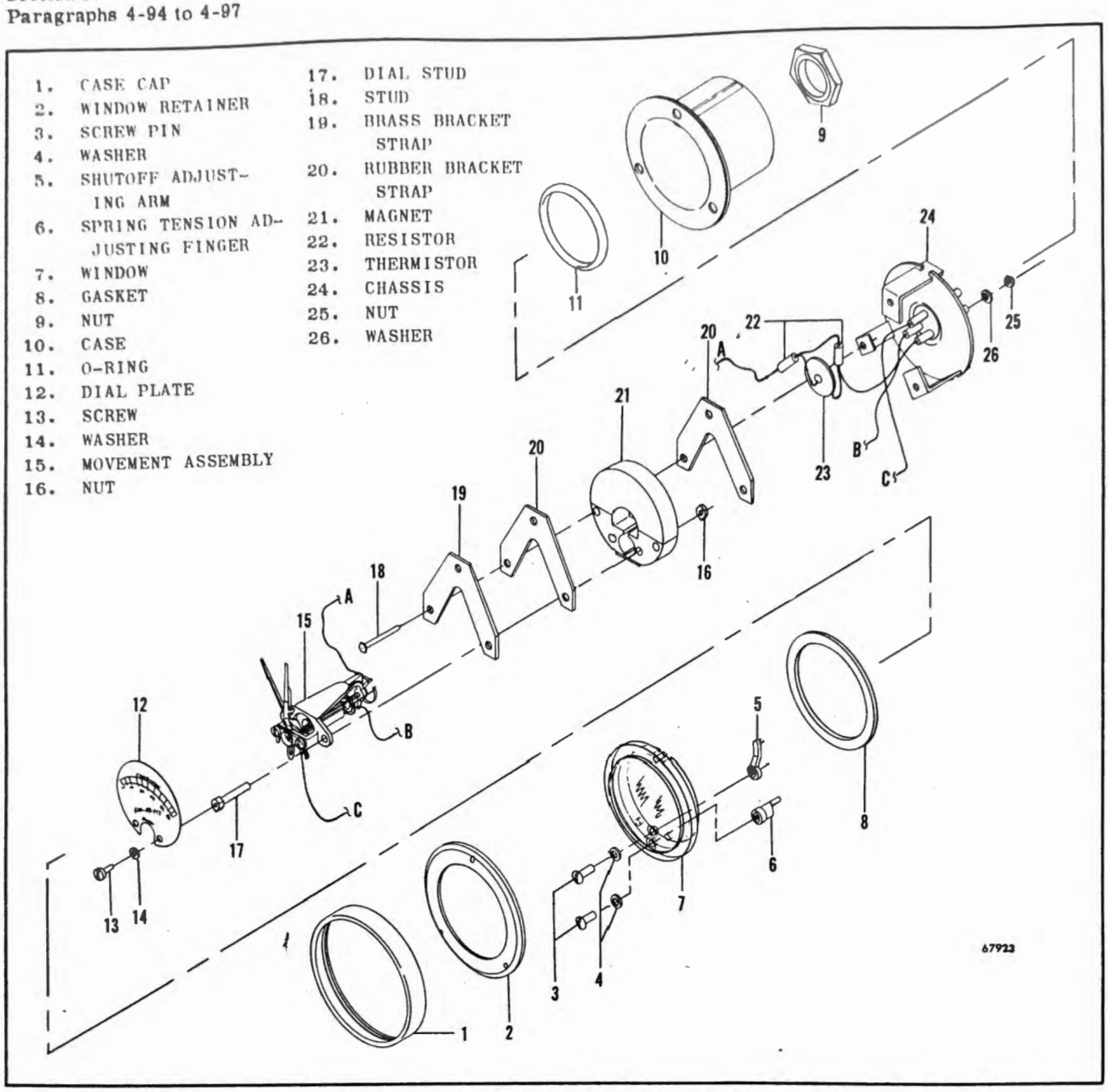


FIGURE 4-26. EXHAUST TEMPERATURE PYROMETER

solder these leads with a small soldering iron being very careful not to damage any part of movement. Do not remove movement unless necessary.

f. Remove three special studs (18), which will free brass bracket strap (19), two rubber bracket straps (20) and magnet assembly (21) from the chassis.

g. Two resistors (22) and thermister (23) are removed by unsoldering their leads with a small soldering iron, but should be removed only when necessary.

h. From chassis (24) remove three terminal nuts (25) and three washers (26).

4-94. VOLTAGE REGULATOR.

4-95. SPECIAL TOOLS. No special tools are required for removal of the voltage regulator.

4-96. REMOVAL. (See figure 4-1.) The voltage regulator should be removed from the power package in the following manner:

a. Remove voltage regulator enclosure cover by removing four screws in corners of cover.

b. Remove and tag terminal wire "F" from field winding of starter-generator.

c. Remove and tag terminal wire "A" from armature winding of starter-generator.

d. Remove and tag terminal wire "B" from battery.

e. Remove six screws attaching base of voltage regulator to bottom of enclosure and remove voltage regulator.

4-97. DISASSEMBLY. Disassembly of the voltage regulator is not recommended.

SECTION V

CLEANING

5-1. GENERAL.

5-2. The components of the gas turbine engine and accessories must be thoroughly cleaned after disassembly. Cleaning is necessary for proper inspection, and contributes to the life and efficiency of the engine. A deposit of dirt or oil on the surfaces of the parts can hide cracks or flaws in the material and reduce the amount of heat radiated from the surfaces, as well as constitute a fire hazard.

5-3. PROCESSES.

5-4. Following are processes for cleaning all components of the engine, including materials and equipment required and special instructions where applicable.

5-5. VAPOR DEGREASING (Process 1). This process works on the condensation principle. That is, the vapor rising and condensing on cold parts suspended above the liquid dissolves and removes grease and dirt from the parts. When the part reaches the temperature of the vapor, cleaning action ceases. If further degreasing action is necessary, the part must be removed, cooled and replaced in the degreaser.

CAUTION

To prevent corrosion, each part should be allowed to reach the temperature of the vapor before being removed from the degreaser.

The degreaser equipment should be operated so that vapor is completely condensed as close to the top of the condensing unit as possible, and safely below the top of the tank. A good operating temperature of the cooling water when measured at its outlet is approximately 37.8°C (100°F).

WARNING

Adequate precautions should be taken to prevent exposure of personnel to the vapors of trichlorethylene.

Trichlorethylene, Specification MIL-T-7003, is the only type of trichlorethylene satisfactory for use in engine parts cleaning. The ph or relative acidity of the trichlorethylene solution should be checked periodically. The alkalinity of the trichlorethylene should not be allowed to drop below 0.01 percent NaOH. New trichlorethylene should be added to the solution in the tank when the NaOH concentration drops to 0.01 percent. If the concentration of NaOH of the trichlorethylene in the tank cannot be brought up to 0.01 percent by weight, by the addition of new trichlorethylene, the solvent in the degreaser should be replaced.

NOTE

Trichlorethylene prepared for dry-cleaning should never be used for parts degreasing.

5-6. GENERAL SOLVENT BATH (Process 2). Parts cleaned by this process may be sprayed or immersed. The solution used is dry-cleaning solvent, Specification P-S-661b. In a solvent spray booth foreign matter should be removed from the parts by means of a brush and a solvent flush. The parts should be finally cleaned in the booth by flushing with clean solvent. The booth should be mechanically exhausted with a minimum face velocity of 150 feet per minute.

NOTE

Solvent used to clean parts should be drawn from a filtered source of supply to avoid contaminating work that has been partially cleaned.

Cleaning parts by immersion in solvent requires equipment consisting of a cabinet containing a pump, a filter unit (filter should be as fine as possible) and a flexible metal hose to flush cavities of parts.

WARNING

Adequate personal protective equipment should be provided to prevent contact with the solvent mixture.

5-7. ALCOHOL SOLVENT WASH (Process 3). Clean external surfaces with a soft lint free cloth or soft brush dampened in alcohol. The solution for this process is isopropyl alcohol, Specification MIL-F-5566.

5-8. LACQUER THINNER BATH (Process 4). Immerse part in solution until foreign matter is dislodged. The solution for this bath is lacquer thinner, Specification 36508.

5-9. VAPOR BLAST CLEANING (Process 5). Parts cleaned by this process are subjected to a high velocity stream of atomized water containing an abrasive. Equipment similar to a Pangborn Hydro-Finish machine, Type EZ, is suitable, using a water and grit mixture with 625 mesh (or finer) grit. Corrosion of ferrous parts is prevented by dipping in a suitable corrosion inhibitor after cleaning, or including the inhibitor in the water and grit mixture.

CAUTION

Any blast cleaning procedure tends to hide fine defects by peening over or smearing, unless extreme care and the lowest possible water

pressure consistent with thorough cleaning is used. Do not concentrate the blast in any one area, especially on sections such as blade edges. Turbine wheels and nozzle box vanes should be cleaned with particular care because of the fineness of defects associated with these components.

5-10. AIR BLAST FOR DRYING (Process 6). Use filtered dry compressed air.

5-11. CORROSION PREVENTION (Process 7). After cleaning and drying, the part should be coated by dipping, spraying or brushing with the following corrosion preventive mixture: one part corrosion preventive compound Specification MIL-C-6529, Type I, and three parts lubricating oil, Specification MIL-O-2104 (SAE 10). The corrosion preventive mixture should be thoroughly mixed and heated to a temperature of 102°C (215°F) - 107°C (225°F), immediately prior to use, to evaporate any moisture suspended in the mixture.

5-12. SELECTION OF CLEANING PROCESSES.

5-13. All components of the engine and accessories that require cleaning, are listed in table IV along with references to the appropriate cleaning process (or processes) for each. The time period required for each process will vary depending upon the condition of the individual part. The process should be discontinued however, when the part becomes clean enough for adequate inspection. Refer to the figure and index number columns of table IV to locate the figures in which the parts are illustrated.

TABLE IV. CLEANING REQUIREMENTS
(Refer to paragraph 5-5 through 5-11 for process by number.)

Figure No.	Index No.	Nomenclature	Process	Process	Process	Process	See Note
4-1	5	Thermocouple, exhaust	2				
4-1	13	Thermocouple, air	2				
4-1	14, 15	Exhaust collector assy	5				G
All		Tubing, aluminum	2	6			
All		Tubing, stainless steel	2	6			
All		Hose, rubber	2	6			
4-1	23	Relay, starter	3	6			H
4-1	24	Voltage regulator	3	6			H
All		Brackets, aluminum	2				B
4-2	23	Spacer, engine mount	2				
All		Clamps, stainless steel	2				
4-2	24	Bracket, Lord mount	2				B
4-2	16	Nozzle ring assy	5	1			
4-3	5	Valve, relief	2	6			C
All		Nuts, washers and bolts	2				
All		Hose and tubing fittings	2	6			
4-4	25	Body, oil separator	2				B, C, G
4-4	25	Cover, oil separator	2				B
4-4	33	Bracket, oil separator	2				B

TABLE IV. CLEANING REQUIREMENTS (Continued)
(Refer to paragraph 5-5 through 5-11 for process by number.)

Figure No.	Index No.	Nomenclature	Process	Process	Process	Process	See Note
4-4	50	Strainer assy	2	6			C
4-4	80	Manifold, oil	2	6			C
4-4	84	Oil jet assy	2	6			
4-4	94	Breather assy	2				B, C
All		Wiring					
4-6	1	Air collector assy	2				B, F
4-6	7	Tube assy, second-stage	2				B, F
4-6	12	Tube assy, first-stage	2				B, F
4-6	18	Jet, oil	2	6			
4-6	19	Bearing	2	6	7		
4-6	20	Housing assy, drive accessory	2	6			B, G
4-6	21	Adapter, shaft	2	7			
4-6	34	Housing, first-stage	2				B, C, G
4-6	35	Retainer, insert bearing	2	6	7		
4-6	36	Bushing	2	6	7		
4-6	37	Bearing, roller	2	6	7		D
4-6	38	Oil seal	2				
4-6	39	First-stage impeller	5	1			G
4-6	40	Spacer	2				
4-6	46	Hoist fitting	2				B
4-6	47	Housing, interstage	2	6			B, C, G
4-6	48	Air seal	2	7			
4-6	49	Second-stage impeller	5	1			G
4-6	50	Spacer	2				
4-6	53	Cap assy	2	6			
4-6	54	Oil seal	2				
4-6	55	Retainer plate	2	6	7		
4-6	56	Ball bearing	1	2	6	7	D,K
4-6	57	Bearing retainer	2	6	7		

TABLE IV. CLEANING REQUIREMENTS (Continued)
(Refer to paragraph 5-5 through 5-11 for process by number.)

Figure No.	Index No.	Nomenclature	Process	Process	Process	Process	See Note
4-6	58	Wheel and shaft assy	5	1			E. G
4-6	62	Inner cone assy	5				
4-6	64	Bearing cap assy	2				
4-6	65	Retainer plate	2	6	7		
4-6	66	Bearing	2	6	7		
4-6	67	Bearing retainer	2	6	7		
4-8	7	Gear, input	2	6	7		
4-8	8	Gear, output	2	6	7		
4-8	9	Plug, gear	2				
4-8	11	Accessory pod	2				B, G
4-8	16	Nut, lock	2				
4-8	18	Gear, 81 tooth	2	6	7		
4-8	19	Bearing	1	2	6	7	D,K
4-8	20	Bearing	1	2	6	7	D,K
4-8	22	Spacer	2	6	7		
4-8	23	Accessory pod	2				B, G
4-8	27	Cap, bearing	2				B, G
4-8	30	Shim	2				
4-8	31	Nozzle, lube jet	2	6			
4-8	37	Cap, end	2				B, G
4-8	44	Cover	2				B, G
4-8	45	Body	2				B, G
4-8	46	Bushing	2				
4-8	51	Bearing	1	2	6	7	D
4-8	52	Bearing	1	2	6	7	D
4-8	54	Spacer	2				
4-8	56	Accessory pod	2				B, G
4-8	57	Bearing	1	2	6	7	D,K
4-8	59	Gear, cluster	2	6	7		

TABLE IV. CLEANING REQUIREMENTS (Continued)
(Refer to paragraph 5-5 through 5-11 for process by number.)

Figure No.	Index No.	Nomenclature	Process	Process	Process	Process	See Note
4-8	62	Gear, 96 tooth	2	6	7		
4-8	63	Gear, 57 tooth	2	6	7		
4-8	67	Plate, cover	2				B, G
4-8	71	Gear, helical	2	6	7		
4-8	73	Shim	2				
4-8	76	Bearing	1	2	6	7	D,K
4-8	77	Spindle	2	6	7		
4-9	10	Tube assy, crossfire	1				
4-9	11	Nipple, crossfire tube	2				
4-9	12	Ball sleeve, crossfire tube	2				
4-9	16	Plug assy, vapor spark	2				B
4-9	18	Liner assy, burner	5	1			
4-9	19	Shell assy, burner	2				B, G
4-9	21	All burner seal rings	2				B
4-9	27	Cover	2				B, G
4-9	29	Adapter	2	6			
4-9	30	Spacer	2				
4-9	31	Elbow assy, burner	2				B, C, G
4-9	32	Nozzle, fuel	2	6			
4-10	6	Coil assy, igniter	2	6			H
4-10	26	Casing, front compressor	2				B, C, G
4-10	28	Fairing nut	2				
4-10	32	Impeller assy	5	1	2		G
4-10	33	Key, square	2	7			
4-10	36	Cap, bearing	2	6			
4-10	37	Slinger, oil	2	6	7		
4-10	38	Plate, retainer	2	6	7		
4-10	39	Turbine wheel and shaft assy	5	1			E, G
4-10	41	Pinion, 24-tooth drive	2	6	7		

TABLE IV. CLEANING REQUIREMENTS (Continued)
(Refer to paragraph 5-5 through 5-11 for process by number.)

Figure No.	Index No.	Nomenclature	Process	Process	Process	Process	See Note
4-10	42	Bearing	1	2	6	7	D
4-10	43	Bearing retainer	2	6	7		
4-10	45	Air deflector	2				B
4-10	46	Ring assy, insulating	2	6			B
4-10	49	Nozzle box assy	5	1			
All		Heat shields	5				
4-10	53	Bearing cap and oil seal	2	6			B, G
4-10	56	Plate, retainer	2	6	7		
4-10	57	Bearing, floating	2	6	7		
4-10	58	Retainer, bearing	2	6	7		
4-10	66	Casing, rear compressor	2				B, C, G
4-10	73	Rotor housing	2				B, C, G
4-13	6	Dip stick	2				
4-13	7	Fitting, dip stick	2				
4-13	9	Bracket	2				B
4-13	13	Strainer assy	2	6			
4-13	25	Oil sump and base assy	2				B, C, G
4-14		Fuel pump and governor assy	2	6			
4-15		Acceleration limiter	2	6			
4-16		High pressure fuel filter	2				
4-17	2	Fuel solenoid electromagnet					A
4-17	1	Valve body	2	6			C
4-17	3	Valve plunger	2				
4-17	4	Valve plunger guide	2				
4-18		Lube and scavenge pump	2	6			
4-19		Oil pressure switch	2	6			
4-20		Starter-generator	2	6			I
4-21		Tachometer generator	2	6			I
4-23		Fuel filter	2				

TABLE IV. CLEANING REQUIREMENTS (Continued)
(Refer to paragraph 5-5 through 5-11 for process by number.)

Figure No.	Index No.	Nomenclature	Process	Process	Process	Process	See Note
4-24		Lube filter	2				
4-25	1	Adapter flange	2				
4-25	7	Outer shell	2				
4-25	11	Outer dome	2				
4-25	17	Inner dome	2				
4-25	18	Inner shell	2				
4-26		Exhaust temperature pyrometer					J

NOTES TO TABLE IV

NOTE A — No cleaning necessary, other than wiping with a cloth or soft brush.

NOTE B — Use Process 5 to remove any paint or foreign deposits not removed by cleaning process shown.

NOTE C — If necessary, threads and holes may be cleaned by use of a wire or fibre tube brush.

NOTE D — Do not spin bearings with compressed air.

NOTE E — Fingerprint removal compound, Specification AF 14156 or MIL-R-15074, is applied to bearing surfaces of shaft, immediately after cleaning to prevent possible corrosion.

NOTE F — A hard deposit of baked oil on surface of part can be removed by soaking part in lacquer thinner, Specification AF 36508.

NOTE G — Do not blast clean threaded, bearing or faying surfaces. These must be protected by masking with heavy tape or with a fibre, soft aluminum or copper sleeve.

NOTE H — Clean electrical contacts with a very fine polishing cloth. Polish only enough to make certain that the contacts are clean and bright.

NOTE I — Clean lubricated parts with solvent per Process 2, and dry per Process 6. Blow out stator assembly, rotor assembly and end bell with air at low pressure.

NOTE J — Clean the case with solvent, per Process 3. Clean external terminal connections with wire brush.

NOTE K — Use Process 1 only if new bearing is coated with heavy grease.

SECTION VI

INSPECTION, REPAIR, REPLACEMENT AND TABLE OF LIMITS

6-1. GENERAL.

6-2. The methods and procedures listed in Section VI are required during overhaul of the gas turbine engine, model 502-7D. Long life and continued efficient operation of the engine and accessories depend upon the care and accuracy with which inspections are conducted and repairs and replacements accomplished.

6-3. INSPECTION.

6-4. VISUAL INSPECTION. A visual inspection involves viewing the part to determine its general physical condition and the extent of wear, deterioration or distortion that the part has undergone since build-up or last overhaul of the engine. The general physical conditions which may require repair or replacement of engine components (except for minute discontinuities) can usually be established by visual inspection. Definition of some of the common terms denoting damage, usually discernible by visual inspection, are listed below.

a. Dents are slight depressions, notches or hollows caused by a blow or by pressure, usually as a result of careless handling of parts.

b. Grooves are smooth rounded furrows due to concentrated wear, or parts being out of alignment.

c. Scratches are narrow shallow grooves in the surface of a part and are usually caused by foreign material in the lubrication system or by careless handling of the part.

d. Metal build-up is the forming of high spots on the surfaces between stationary and rotating parts and is usually due to insufficient clearance, lack of proper lubrication or foreign material entering the engine.

e. Peening of edges is a rounding or flattening of the edge, usually caused by the repeated impact of foreign material or objects against the edge.

f. Cracks indicate partial failure of the part and are usually due to excessive stress, overheating or defective material.

g. Chipping is the breaking out of small particles of metal and is usually due to careless handling or improper fit.

h. Corrosion is the gradual wearing or eating away by chemical action and is the result of inadequate preservative measures.

i. Burring is the appearance of sharp projections or rough edges due to excessive wear or careless handling.

j. Abrasion is multiple scratching of a surface and is usually due to foreign material between moving parts.

k. Galling is a chafing, fretting or wearing away by friction.

l. Spalling is the flaking or breaking away of a portion of a gear tooth due to heat and abrasive action.

6-5. FLUORESCENT PENETRANT INSPECTION. Inspection by the fluorescent penetrant method requires that the parts be either immersed, painted or sprayed on the entire surface to be inspected with fluorescent penetrant material. A properly filtered black light is used in a darkness booth to detect cracks or other surface discontinuities which cannot be detected by visual inspection. No part should be fluorescent penetrant inspected until a close visual inspection has been made. A close visual inspection will eliminate the time required to conduct fluorescent penetrant inspection of obviously defective parts. Fluorescent penetrant inspection should be accomplished on the parts listed in Table V in accordance with specification MIL-I-6866.

6-6. MANDATORY REPLACEMENT ITEMS. A visual inspection of the parts which are replaced at every overhaul of the engine should be made since these parts may reflect malfunction of other components in the engine. Following is a list of the mandatory replacement items:

a. Fuel nozzles.
b. Bearings and bushings.
c. Gaskets, seals and O-rings.
d. Snap and retaining rings.
e. Self-locking and fibre-locking nuts.
f. Cotter pins and lockwire.
g. Star and tab-type lock washers.
h. Oil and fuel filter elements.
i. Starter-generator brushes.
j. Insulation pads in inlet silencer.

6-7. MAGNETIC PARTICLE INSPECTION. Inspection by the magnetic particle inspection process requires that the parts be free of grease or other foreign matter which would interfere with the proper distribution, intensity, character or definition of the deposit of the magnetic substance. This inspection should be accomplished in accordance with specification MIL-I-6868 but only after a close visual inspection of the part has revealed no rejectable defects. Refer to Table V for a list of the parts to be inspected by magnetic particle inspection.

TABLE V. MAGNETIC AND FLUORESCENT INSPECTION

FIGURE & INDEX NO.	NOMENCLATURE	FLUORESCENT PENETRANT	MAGNETIC PARTICLE	SPECIAL POINTS
	ENGINE ASSEMBLY			
4-1, 14	Exhaust collector shell, left	x		Weld areas
4-1, 15	Exhaust collector shell, right	x		Weld areas
4-2, 16	Nozzle ring	x		Weld areas
	ENGINE LUBRICATION SYSTEM			
4-4, 67	Lube and scavenge pump shaft		x	Shoulders and splines
	BURNER SECTION			
4-9, 18	Liners	x		See 6-10d, e
4-9, 19	Burner shells	x		See 6-10b, c
4-9, 10	Crossfire tube	x		See 6-10f
	ROTOR SECTION			
4-10, 32	Impeller	x		See 6-13
4-10, 37	Oil slinger		x	Labyrinth
4-10, 41	24-tooth drive pinion		x	Tooth area
4-10, 39	Turbine wheel and shaft assembly	x	x	See 6-14
4-10, 38	Retainer plate		x	-
4-10, 56	Retainer plate		x	--
4-10, 60	Retainer plate		x	-
4-10, 43	Bearing retainer		x	-
4-10, 58	Bearing retainer		x	-
4-10, 62	Bearing retainer		x	-
4-10, 49	Nozzle box assembly	x		See 6-11
	TWO-STAGE COMPRESSOR ASSEMBLY			
4-6, 35	Insert bearing retainer		x	-
4-6, 55	Bearing retainer plate		x	-
4-6, 65	Bearing retainer plate		x	-
4-6, 57	Bearing retainer		x	-
4-6, 67	Bearing retainer		x	-
4-6, 62	Inner cone assembly	x		Weld area
4-6, 1	Air collector assembly	x		Weld and dented areas

TABLE V. MAGNETIC AND FLUORESCENT INSPECTION (Continued)

FIGURE & INDEX NO.	NOMENCLATURE	FLUORESCENT PENETRANT	MAGNETIC PARTICLE	SPECIAL POINTS
4-6, 38	Oil slinger		x	Labyrinth
4-6, 54	Oil slinger		x	Labyrinth
4-6, 39	Impeller assembly	x		See 6-13
4-6, 49	Impeller assembly	x		see 6-13
4-6, 48	Interstage air seal		x	Labyrinth
4-6, 58	Wheel and shaft assemblies	x	x	See 6-14
	ACCESSORY DRIVE ASSEMBLY			
4-8, 27	Bearing cap	x		Bearing seat
4-8, 7	Input gear		x	Tooth area
4-8, 8	Output gear		x	Tooth area
4-8, 18	81-tooth gear		x	Tooth area
4-8, 49	81-tooth governor drive gear		x	Tooth area
4-8, 59	Cluster gear		x	Tooth areas
4-8, 62	96-tooth gear		x	Tooth area
4-8, 63	57-tooth gear		x	Tooth area
4-8, 71	Helical gear	x		Tooth area
4-8, 77	Spindle		x	-

6-8. HOSES, TUBES AND FITTINGS. Visually inspect all hoses and tubes for breaks, cracks, excessive wear, signs of corrosion or damage. Inspect all fittings for broken threads, deterioration and cleanliness. Reject any so damaged.

6-9. OIL REFUSE. Oil drained from the engine prior to disassembly should be inspected for metal particles. If excessive metal particles are found, there is a good chance that the engine has sustained internal damage.

6-10. BURNER SECTION. The burner section should be inspected in the following manner:

a. Visually inspect burner elbow casting for cracks and security of guide vanes in elbow. If vanes are loose enough to jar out, reject elbow. Inspect for loose Rosan inserts.

b. Visually inspect burner shell, and particularly liner support segments, for cracks. If cracks are found in segments, reject burner shell. Other cracks may be repaired in accordance with instructions in paragraph 6-36. If liner support ring has worn to a thickness of .020 inches, or less, at any point, reject shell.

c. Fluorescent penetrant inspect burner shell for cracks per specification MIL-I-6866.

d. (See figure 6-1.) Visually inspect burner liner for distortion. Maximum allowable depth of liner distortion (item 9) is .125 inch. There is no limit on area of distortion (item 6). Replace liner if distortion is evident in more than two areas. Inspect dome fitting of liner (item 7) for looseness. If loose, reject liner. Inspect vapor spark plug boss and crossfire tube boss on liner for wear due to chafing. If excessively worn or cracked, reject liner (item 10). Inspect liner skirt for chafing. Cracking is usually localized to area around bosses (item 8). Inspect liner dome for cracking. Reject liner if dome is cracked. Inspect liner skirt for cracking. Reject skirt if cracks exceed 1/4 inch.

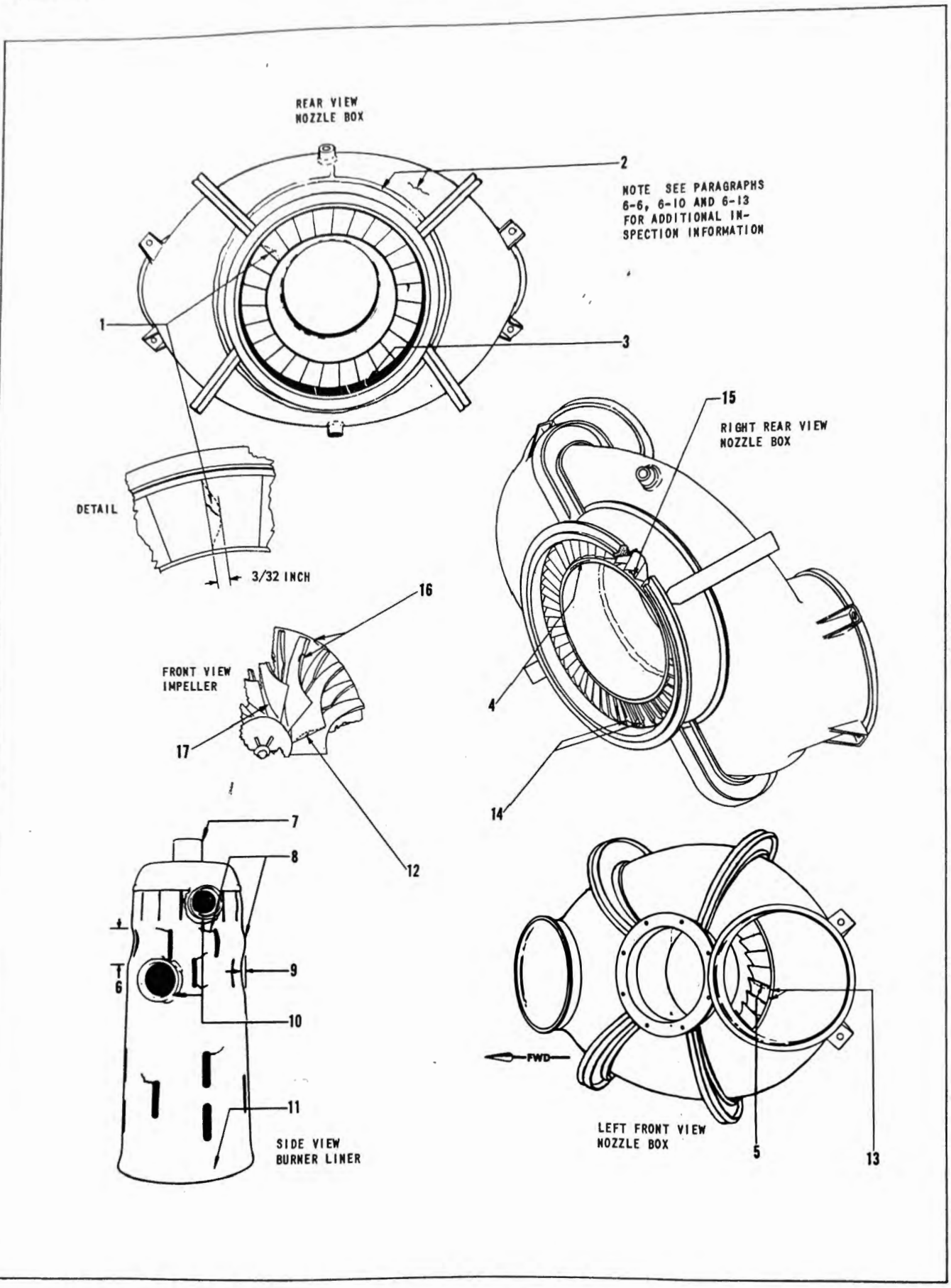


FIGURE 6-1. INSPECTION OF NOZZLE BOX, BURNER LINERS AND IMPELLERS (Sheet 1 of 2)

INSPECT FOR THE FOLLOWING DEFECTS

ITEM	
1.	Cracks greater than 3/32 inch in trailing edge of vanes.
2.	Cracks at welds and in sheet metal of nozzle box.
3.	Cracks in outer shroud of nozzle box (cracks must not join).
4.	Separation of spot welded inner cone of nozzle box.
5.	Cracks greater than 1/8 inch in leading edge of vanes (see paragraph 6-11, step A).
6.	Liner distortion in more than two areas.
7.	Loose dome fittings in liner.
8.	Cracking adjacent to liner bosses.
9.	Distortion deeper than 1/8 inch in liner.
10.	Cracks or excessive wear around bosses of liner.
11.	Chafing and wear around liner skirt.
12.	Cracks or damage deeper than 1/16 inch in impeller.
13.	Cracks in outer shroud that join in such a way as to permit pieces to fall out.
14.	Cracks in outer shroud which if extended would join with other cracks.
15.	Axial cracks in inner shroud of nozzle box.
16.	Cracks in impeller periphery or outer edge of vanes which are greater than 1/16 inch in depth.
17.	Cracks in root fillet of impeller vanes.

FIGURE 6-1. INSPECTION OF NOZZLE BOX, BURNER LINERS AND IMPELLERS (Sheet 2 of 2)

e. Fluorescent penetrant inspect liner per specification MIL-I-6866.

f. Visually inspect crossfire tube (particular attention to bellows), nipples and ball sleeves for cracks. If cracks are found, reject crossfire tube. Fluorescent penetrant inspect crossfire tube, nipples and ball sleeves per MIL-I-6866.

6-11. NOZZLE BOX. (See figure 6-1.) Inspect the nozzle box in the following manner:

a. Cracks (item 5) up to a maximum of 1/8 (.125) inch are permitted in leading edges of not more than three vanes. See paragraph 6-39 for repair instructions.

b. Cracks (item 1) up to a maximum of 3/32 (.0938) inch are permitted in trailing edges of not more than three vanes. See paragraph 6-39 for repair instructions.

c. Cracks in sheet metal and welds (item 2) are acceptable if reparable by welding. There is no limit on the size or number of reparable cracks. Reject nozzle box if any vanes are cracked or distorted. See paragraph 6-39 for repair instructions.

d. Cracks in the outer shroud (item 3) are acceptable if turbine wheel clearance is not affected. If cracks join in such a way as to allow pieces to break out, reject nozzle box.

e. Any separation of the spot-welded inner shroud (item 4) is cause for rejection of nozzle box.

f. Small cracks in forward edge of outer shroud (item 13) are acceptable if they do not join in such a way as will allow pieces to break out.

g. Cracks in the outer shroud are acceptable if turbine wheel clearance is not affected. If cracks are aligned so that they will join with further cracking (item 14) replace the nozzle box.

h. Circumferential cracks (item 15) in this area of the inner shroud are acceptable, but nozzle box should be replaced if any axial cracks are evident.

i. Fluorescent penetrant inspect nozzle box per specification MIL-I-6866.

6-12. NOZZLE RING AND EXHAUST COLLECTOR SHELLS. (See figure 6-2.) Inspect the nozzle ring and exhaust collector shells as follows:

a. Visually inspect nozzle ring for cracked, broken or distorted vanes. Reject nozzle ring if any cracks are found in leading edge of vanes or if vanes are broken or distorted.

b. Visually inspect nozzle ring for sheet metal or weld cracks. Repair welds as described in paragraph 6-40 but reject nozzle ring if any critical clearances (figure 6-5) are affected after welding.

c. For further information for inspection and determination of allowable cracks see figure 6-2.

d. Fluorescent penetrant inspect nozzle ring per specification MIL-I-6866.

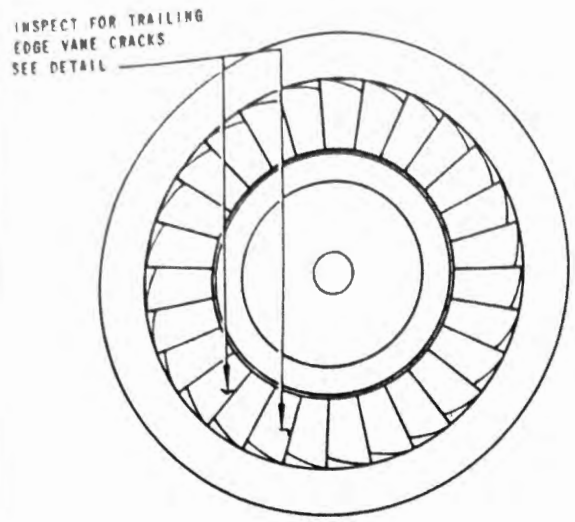
e. Visually and fluorescent penetrant inspect (per MIL-I-6866) exhaust collector shells. If cracks are found, repair by welding as for nozzle ring. (See paragraph 6-40.)

6-13. IMPELLERS. (See figure 6-1.) Inspect all compressor impellers as follows:

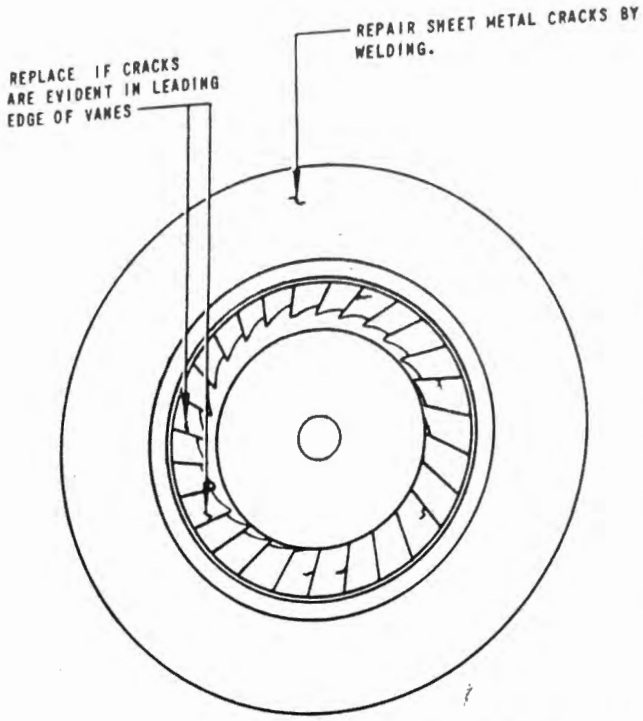
a. Visually inspect impellers for cracks, peening, metal build-up, chipping, burring and abrasion. Repair impeller as described in paragraphs 6-37, 6-48, 6-49, 6-50 and 6-51.

b. Fluorescent penetrant inspect impellers per MIL-I-6866. Reject impeller if cracks in leading edge of vanes (item 12) are greater than 1/16 (.0625) inch in depth. Reject impeller if cracks in impeller periphery or in outer edge of vanes (item 16) are greater than 1/16 inch deep. Reject impeller if any cracks are detected in root fillet.

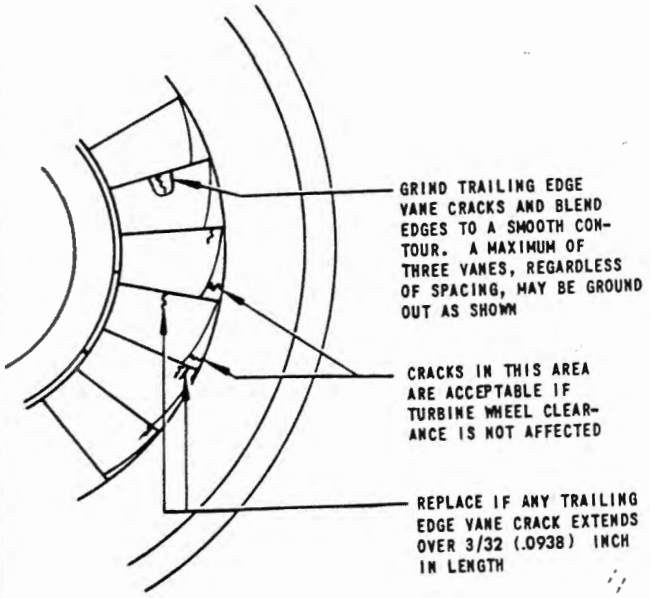
c. The second-stage impeller in the output compressor is to be rejected when the tip diameter measures 8.515 inches or when 1000 hours of operation on the impeller is reached, whichever occurs first.



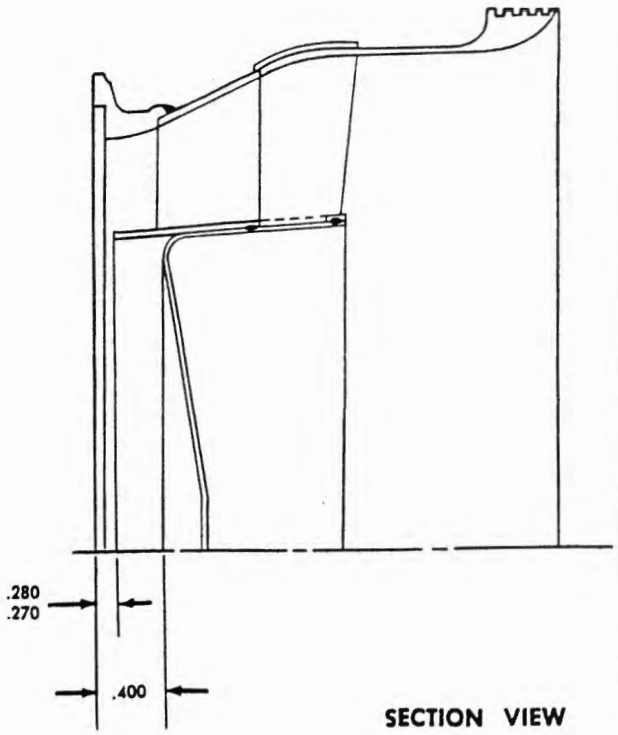
OUTLET END VIEW



INLET END VIEW



DETAIL



SECTION VIEW

FIGURE 6-2. INSPECTION AND REPAIR OF NOZZLE RING

6-14. WHEEL AND SHAFT ASSEMBLIES. (See figure 6-3.) The wheel and shaft assemblies should be inspected as follows:

a. Visually inspect shaft for cracks; reject wheel and shaft assembly if cracks are found.

b. Visually inspect wheel for cracked or broken blades. Reject wheel if any blade is broken or if the length of a crack in any blade is more than 1/16 (.0625) inch.

c. Fluorescent penetrant inspect wheel and shaft assembly per specification MIL-I-6866, and magnetic particle inspect wheel and shaft assembly per specification MIL-I-6868. The fluorescent penetrant inspection is to reveal cracks in wheel and the magnetic particle inspection is to reveal cracks in shaft. For instructions concerning reparable cracks in wheel, see paragraph 6-38.

6-15. ROTOR SECTION. (Refer to paragraphs 6-11, 6-13 and 6-14 for inspection of nozzle box, impeller and wheel and shaft assemblies.) Inspect rotor section components as follows:

a. Visually examine compressor case castings for cracks and distortion. Reject castings if cracked, particularly in diffuser vanes, or if warped so that faying surfaces will not mate properly when fasteners are torqued to limit. If studs are loose or pulled, replace with new studs. (See paragraphs 6-32, 6-33, 6-34 and 6-35.)

b. Visually inspect bearing cap and oil seal assemblies for cracking, warpage and wear. Reject if cracked, warped or worn.

c. Visually inspect rotor housing assembly casting for cracks and loose or pulled Rosan inserts; replace loose Rosans with new inserts (paragraphs 6-32, 6-33, 6-34 and 6-35). Reject housing if cracked.

d. Visually inspect bearing retainers (see items M, N, O, P, figure 6-5) for cracks; reject if cracked. Magnetic particle inspect bearing retainers per specification MIL-I-6868 Reject if cracks are revealed.

e. Visually inspect igniter coil assemblies for cracking and warpage of the castings. Reject castings if warped or cracked. Inspect ignition coil insulation for black carbon tracks; reject coil if tracks are evident.

f. Visually inspect bearing retainer plates for cracking and warpage; reject if cracked or warped. Magnetic particle inspect retainer plates per specification MIL-I-6868. Reject retainer plates if cracks are revealed by magnetic particle inspection.

g. Visually inspect oil slinger for cracks or wear; reject if cracked or worn. Magnetic particle inspect oil slinger per specification MIL-I-6868.

h. Visually inspect 24-tooth drive pinion for cracks or gear wear; reject if cracked or excessively worn. Magnetic particle inspect 24-tooth drive pinion per specification MIL-I-6868.

6-16. SUMP AND BASE SECTION. Inspect the sump and base section components in the following manner:

a. Visually inspect sump and base casting for cracks and pulled or loose studs. Replace loose or pulled studs with new studs (paragraphs 6-32, 6-33, 6-34 and 6-35).

b. Visually inspect strainer assembly screen for damage.

6-17. TWO-STAGE COMPRESSOR. Inspect the two-stage compressor components in the following manner:

a. Visually inspect inner cone assembly for cracks and warpage. Reject if inner cone is excessively cracked or warped or if cone warps after repair-welding. Fluorescent penetrant inspect inner cone assembly per MIL-I-6866. If fluorescent inspection reveals any cracks, repair by welding, but reject inner cone assembly if distortion results from welding. (See paragraph 6-40.)

b. Visually inspect bearing cap and oil seal assemblies for wear, cracking and warpage; reject if cracked, warped or worn.

c. Visually inspect retainer plates for cracking and warpage; reject if cracked or warped. Fluorescent penetrant inspect retainer plates per specification MIL-I-6866. Reject plates if cracked.

d. Visually inspect bearing retainers and insert bearing retainer for cracking and warpage; reject if cracked or warped. Fluorescent penetrant inspect retainers per specification MIL-I-6866. Reject retainers if fluorescent inspection reveals cracks.

e. Visually inspect oil slingers and interstage air seal for wear and cracks; reject if worn or cracked. Magnetic particle inspect oil slingers per specification MIL-I-6868. Reject slingers if magnetic inspection reveals cracks.

f. Visually inspect machining housing assembly castings for cracking and distortion. If castings are distorted so that faying surfaces will not mate properly with fasteners torqued to limit, reject and replace all three castings. If any studs are loose or pulled, replace with new studs. (See paragraph 6-32, 6-33, 6-34 and 6-35.)

g. Visually inspect first-stage and second-stage tubes for cracks. Reject tubes if cracked.

h. Visually inspect air collector assembly, particularly at dented and weld areas, for cracks. Fluorescent penetrant inspect (per MIL-I-6866) air collector assembly for cracks, paying particular attention to weld and dented areas. If cracks are found, repair in accordance with instructions in paragraph 6-45.

6-18. ACCESSORY DRIVE ASSEMBLY. Inspect the accessory drive assembly as follows:

a. Visually inspect machining assembly castings for cracking and distortion. Reject if cracked or if castings are distorted so that faying surfaces will not mate properly when fasteners are torqued to limit. Inspect studs for security; replace loose or pulled studs with new studs.

b. Visually inspect all gears and spindle. If 25% of any tooth is spalled or if the wearing surface of any spiral gear is scored or pitted the gear should be rejected. Magnetic particle inspect all gears, except bronze helical gear. Fluorescent penetrant inspect bronze helical gear per specification MIL-I-6866. If any cracks are detected reject gear. Check gear wear with an involute profile checker; the wearing surface should not deviate from the original surface over .002 inch. Deviation beyond this limit is cause for rejection.

c. Visually inspect bearing cap for cracks and scaring of bearing seat; reject if cracked or if bearing set is scored. Fluorescent penetrant inspect bearing cap per specification MIL-I-6866.

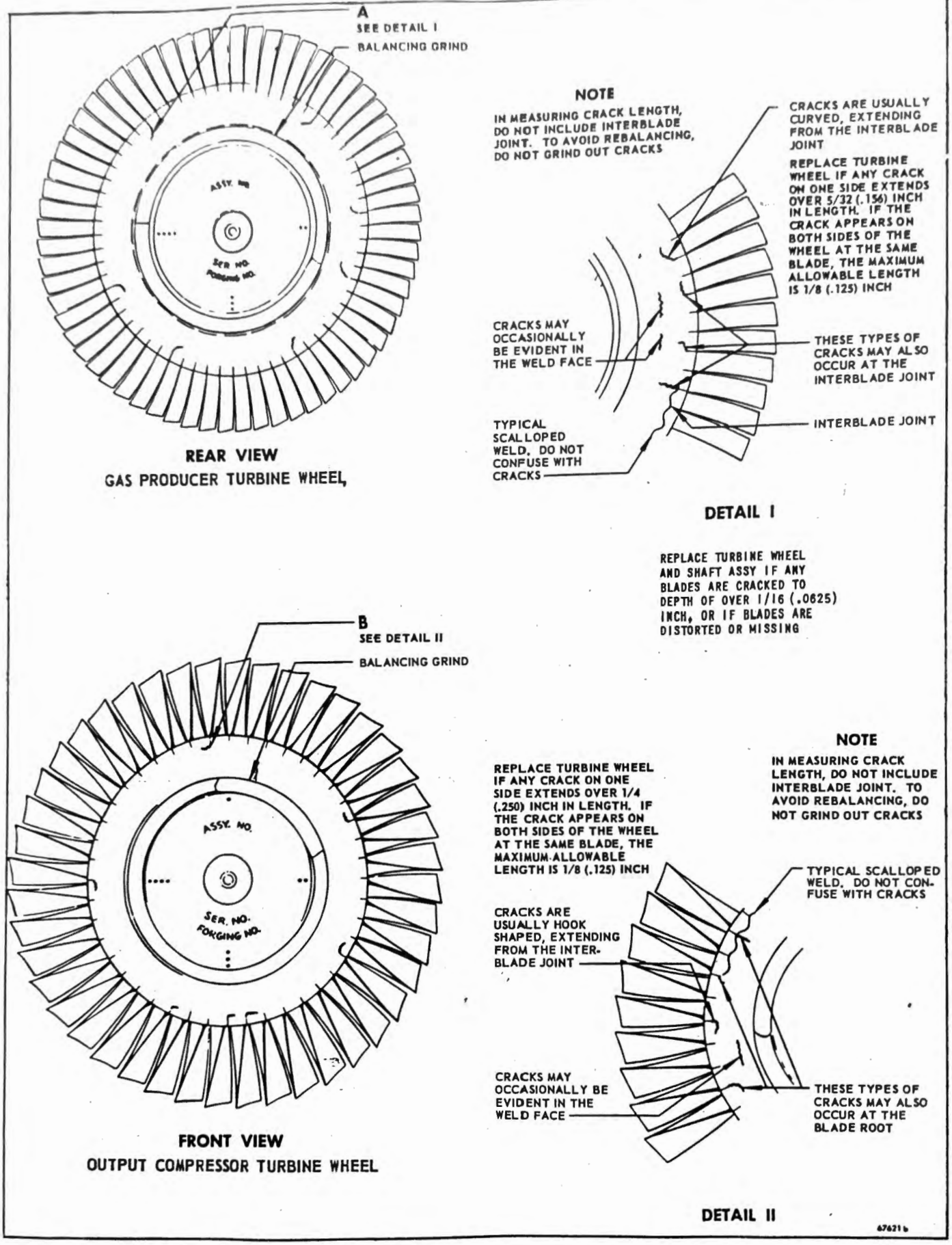
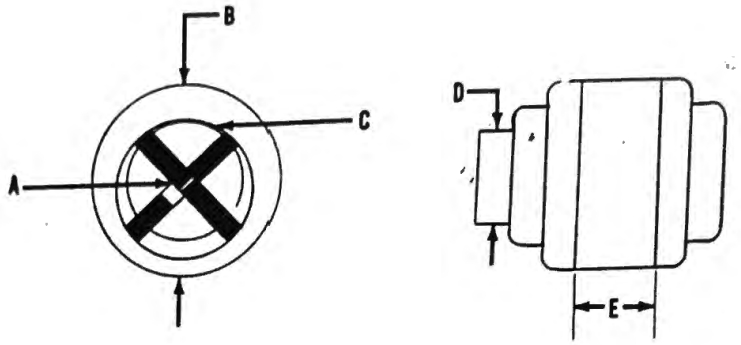


FIGURE 6-3. INSPECTION OF TURBINE WHEELS



Ref. Letter	Location	Element	Dimension New Max	Dimension New Min	Clearance New Max	Clearance New Min	Permissible Worn Dim. Max or Min	Permissible Worn Clearance Maximum
A	Blade in Rotor Slot	Slot Width	0.126	0.125			No Wear	
		Blade Width	0.1243	0.1238	0.0022	0.0007	0.1233 Min.	0.0027
B	Blade in Liner	Liner Bore	1.153	1.152			No Wear	
		Blade Radial Length (2 blades)	1.149	1.147	0.005	0.003	1.145 Min.	0.008
C	Rotor in Liner	Seal Clearance			0.0025	0.0015	No Wear, Check bearing, see D.	
D	Rotor Shaft in Bearing	Bearing Bore Diameter	0.688	0.6875			0.6885 Max.	
		Rotor Shaft Diameter	0.6865	0.6860	0.002	0.001	0.6860 Min.	0.0025
E	Blade in Liner Between Bearings	Liner Length (Between Bearings)	0.7565	0.7560			0.7565 Max.	
		Blade Length	0.7550	0.7545	0.0020	0.0010	0.7540 Min.	0.0025

FIGURE 6-4. LUBE AND SCAVENGE PUMP CLEARANCES

6-19. FUEL PUMP. Visually inspect fuel pump as follows:
a. Inspect castings for cracks and warpage; reject if cracked or warped so that faying surfaces will not mate properly with fasteners torqued to limit.
b. Inspect coil and wafer springs for cracks and breaks; reject if cracked or broken.
c. Inspect diaphragm for rupture; reject if ruptured.

6-20. FUEL CONTROL GOVERNOR. Visually inspect fuel control governor as follows:
a. Inspect for cracks and warpage; rejected if cracked or if distorted so that faying surfaces will not mate properly when fasteners are torqued to limit.
b. Examine all springs for cracks or breaks; reject if cracked or broken.
c. Inspect relief valve piston for galling; reject piston if galled.

6-21. ACCELERATION LIMITER. Visually inspect acceleration limiter as follows:
a. Inspect castings for cracking and distortion; reject if cracked or distorted.
b. Examine diaphragm for rupture; reject if ruptured or torn.
c. Examine springs for cracks or breaks; reject if cracked or broken.

6-22. LUBE AND SCAVENGE PUMP. (See figure 6-4.) Visually inspect lube and scavenge pump in the following manner:
a. Inspect castings for cracking and distortion; reject if cracked or warped.
b. Examine blades for edge wear; reject if excessively worn.
c. Inspect liner inner walls for wear and scoring; reject if worn excessively or scored.
d. Examine springs for cracks or breaks; reject if cracked or broken.
e. Inspect relief valve for galling on sides or darkened surface on seat. Repair as described in paragraph 6-43. If, after repair, pump pressures continue to be erratic, reject pump.

6-23. STARTER-GENERATOR. Inspect starter-generator in following manner:
a. All parts must show no signs of damage or corrosion.
b. The rotor assembly shaft must be perpendicular with bearing lands to within .001 inch full indicator reading.
c. The face of commutator must be concentric with shaft to within .001 inch total indicator reading. Resistance between commutator bars 90° apart must be 038 ohm ±10 percent, at temperature 29°C (84°F).
d. Resistance of the series winding of the stator assembly must be .022 ohm and resistance of the shunt winding must be 23.5 ohms, ±10 percent, at temperature of 25°C (84°F).
e. Brush holder assembly brush boxes must be securely riveted in place. Support ring must not be brittle or cracked. Brush springs must show no permanent set and must have sufficient tension to provide a load of 2 pounds, ±2 ounces.

6-24. OIL PRESSURE SWITCH. Visually inspect oil pressure switch as follows:
a. Inspect spring for cracks or breaks; reject if cracked or broken.
b. Examine microswitch housing for evidence of cracking or breaking; reject if cracked or broken. Check freedom of action of microswitch and pressure peg; reject switch if pressure peg does not move in and out smoothly.
c. Inspect for security of wire terminals on microswitch. Resolder terminals if loose or broken.
d. Reject oil pressure switch if any oil is present inside body assembly.

6-25. HIGH PRESSURE FUEL FILTER. Visually inspect high pressure fuel filter as follows:
a. Inspect castings for cracks and distortion; reject if cracked, or distorted enough so that parts will not assemble properly.
b. Inspect relief valves for galling; reject if galled.
c. Inspect springs for cracks or breaks; reject if cracked or broken.

6-26. RELIEF VALVE. Visually inspect piston for galling and examine rubber end for wear and cracking; reject if badly galled or if rubber is cracked so it will not provide positive seal.

6-27. LUBE SYSTEM. Visually inspect oil separator assembly strainer, oil-jet screen and strainer assembly element for clogging.

6-28. LUBE FILTER. Visually examine case and cover assemblies for cracks and distortion. Reject if cracked or if distorted so that parts will not assemble properly.

6-29. AIR FLOW CONTROL ASSEMBLY. Visually inspect the air flow control assembly in the following manner:
a. Inspect all castings for cracking and distortion; reject if cracked or if distorted so that faying surfaces will not mate properly.
b. Inspect bypass valve piston for wear or galling; reject if worn or galled.
c. Check to determine that all air passages are clean.
d. Inspect poppet stem and cage for galling; reject if galled.
e. Examine diaphragms for rupture; reject if torn or shrunken away from center stem.
f. Examine springs for cracks or breaks; reject if cracked or broken.

6-30. LOW PRESSURE FUEL FILTER. Visually inspect low pressure fuel filter as follows:
a. Inspect castings for cracking and distortion; reject if cracked or if distorted so that parts cannot be assembled properly.
b. Inspect springs for cracks or breaks; reject if cracked or broken.
c. Examine relief valves for wear or galling. Repair as described in paragraph 6-43.
d. Inspect cleaning edges of knives for wear which might prevent proper cleaning of element; reject if such wear is evident.
e. Inspect element screen for wear caused by cleaning knives which would allow dirt to pass through filter; reject if such wear is evident.

TABLE VI. INSPECTION AND REPAIR REQUIREMENTS

ITEM	INSPECTION PARAGRAPH REFERENCE	REPAIR-PLACEMENT PARAGRAPH REFERENCE
FUEL SYSTEM		
Fuel pump & governor assy	6-20	6-46
Governor	6-19	6-46
Pump	6-21	6-46
Acceleration limiter	6-25	6-46
High pressure fuel filter	6-26	Not Reparable
Relief valve		
LUBRICATION SYSTEM		
Oil separator assy	6-27	6-46
Strainer assy	6-27	6-46
Oil jet assy	6-27	6-46
Lube & scavenge pump	6-22	6-43
Oil pressure switch	6-24	6-44
BURNER SECTION		
Burner elbow	6-10a	6-32, 6-34, 6-35
Burner shell	6-10b, c	6-36
Burner liner	6-10d, e	Not Reparable
Crossfire tube	6-10f	Not Reparable
ROTOR SECTION		
Balancing assy	-	6-48, 6-50, 6-51
Wheel and shaft assy	6-14	6-38, 6-48, 6-50, 6-51
24 tooth drive pinion	6-15h	Not Reparable
Nozzle box	6-11	6-39
Impeller	6-13	6-37, 6-48, 6-50, 6-51
Compressor casings	6-15a	6-32, 6-33, 6-34, 6-35
Bearing retainer plates	6-15f	Not Reparable
Bearing retainers	6-15d	Not Reparable
Bearing cap & oil seal assy's	6-15b	Not Reparable
Oil slinger	6-15g	Not Reparable
Rotor housing assy	6-15c	6-32, 6-33, 6-34, 6-35
Igniter coil assy	6-15e	6-46

TABLE VI. INSPECTION AND REPAIR REQUIREMENTS (Continued)

ITEM	INSPECTION PARAGRAPH REFERENCE	REPAIR-PLACEMENT PARAGRAPH REFERENCE
SUMP AND BASE SECTION		
Oil sump and base assy	6-16a	6-32, 6-33, 6-34, 6-35
Strainer assy	6-16b	6-46
ENGINE ASSEMBLY		
Nozzle ring	6-12, a, b, c, d	6-40
Exhaust collector shells	6-12e	6-40
TWO-STAGE COMPRESSOR		
Rotor assy	-	6-49, 6-50, 6-51
Inner cone assy	6-17a	6-40
Wheel & shaft assy	6-14	6-38, 6-49, 6-50, 6-51
Impellers	6-13	6-37, 6-49, 6-50, 6-51
Oil slinger	6-17e	Not Reparable
Interstage air seal	6-17e	Not Reparable
Bearing cap & oil seal assys	6-17b	Not Reparable
Bearing retainer plates	6-17c	Not Reparable
Bearing retainers	6-17d	Not Reparable
Insert bearing retainer	6-17d	Not Reparable
Air collector assy	6-17h	6-45
First- and second-stage tube assys	6-17g	6-45
Machining housing assembly	6-17f	6-32, 6-33, 6-34, 6-35
ACCESSORY DRIVE		
Accessory drive housing machining assy	6-18a	6-32, 6-33, 6-34, 6-35
Bearing cap	6-18c	Not Reparable
Input gear	6-18b	Not Reparable
Output gear	6-18b	Not Reparable
81-tooth gear	6-18b	Not Reparable
81-tooth governor drive gear	6-18b	Not Reparable
Cluster gear	6-18b	Not Reparable
57-tooth gear	6-18b	Not Reparable
96-tooth gear	6-18b	Not Reparable

TABLE VI. INSPECTION AND REPAIR REQUIREMENTS (Continued)

ITEM	INSPECTION PARAGRAPH REFERENCE	REPAIR-PLACEMENT PARAGRAPH REFERENCE
Helical gear	6-18b	Not Reparable
Spindle	6-18b	Not Reparable
AIR FLOW CONTROL ASSEMBLY		
Brain assy, bypass valve, venturi expander, check valve and throat castings	6-29a	Not Reparable
Poppet and poppet cage	6-29d	Polish out galling
Bypass valve piston	6-29b	Polish out galling
Diaphragms	6-29e	Not Reparable
Springs	6-29f	Not Reparable
ACCESSORIES		
Starter-generator	6-23	6-41
Low pressure fuel filter	6-30	6-43
Lube filter	6-28	Not Reparable
Voltage regulator	7-67	6-42

6-31. GENERAL REPAIR AND REPLACEMENT.

6-32. REMOVING ROSAN INSERTS. Remove Rosan two-piece inserts in the following manner:

a. Drill out inner serrations of lock ring and serrated collar of insert. Drill to depth of shoulder - i.e., to the first thread of insert. Use drill at high speed.

b. Drive in "ease out" tool or similar square rod.

c. Screw out insert. Note that O.D. of insert thread forces remaining portion of lock ring out as the insert is backed out.

6-33. REMOVING ROSAN TWO-PIECE STUDS. Remove Rosan two-piece studs in the following manner:

a. Using a hollow mill, mill out inner serrations of lock ring and serrated collar of two-piece stud. Mill to depth of shoulder - i.e., to the first thread of stud. Use hollow mill at low speed.

b. Screw out stud.

c. If lock ring fails to come out as the stud is unscrewed, collapse remaining portion of lock ring with a punch.

NOTE

An alternate method of removal is to cut off the stud shank flush with parent material and follow paragraph 6-32.

6-34. INSTALLING ROSAN INSERTS AND STUDS. Install two-piece inserts and studs in the following manner:

a. Drill and counterbore with drill sizes required for stud or insert.

b. Tap threads.

c. Install stud or insert.

d. Drive or press lock ring into position.

6-35. HELI-COIL THREAD INSERTS. Replace damaged Heli-Coil in the following manner:

a. Extract damaged Heli-Coil.

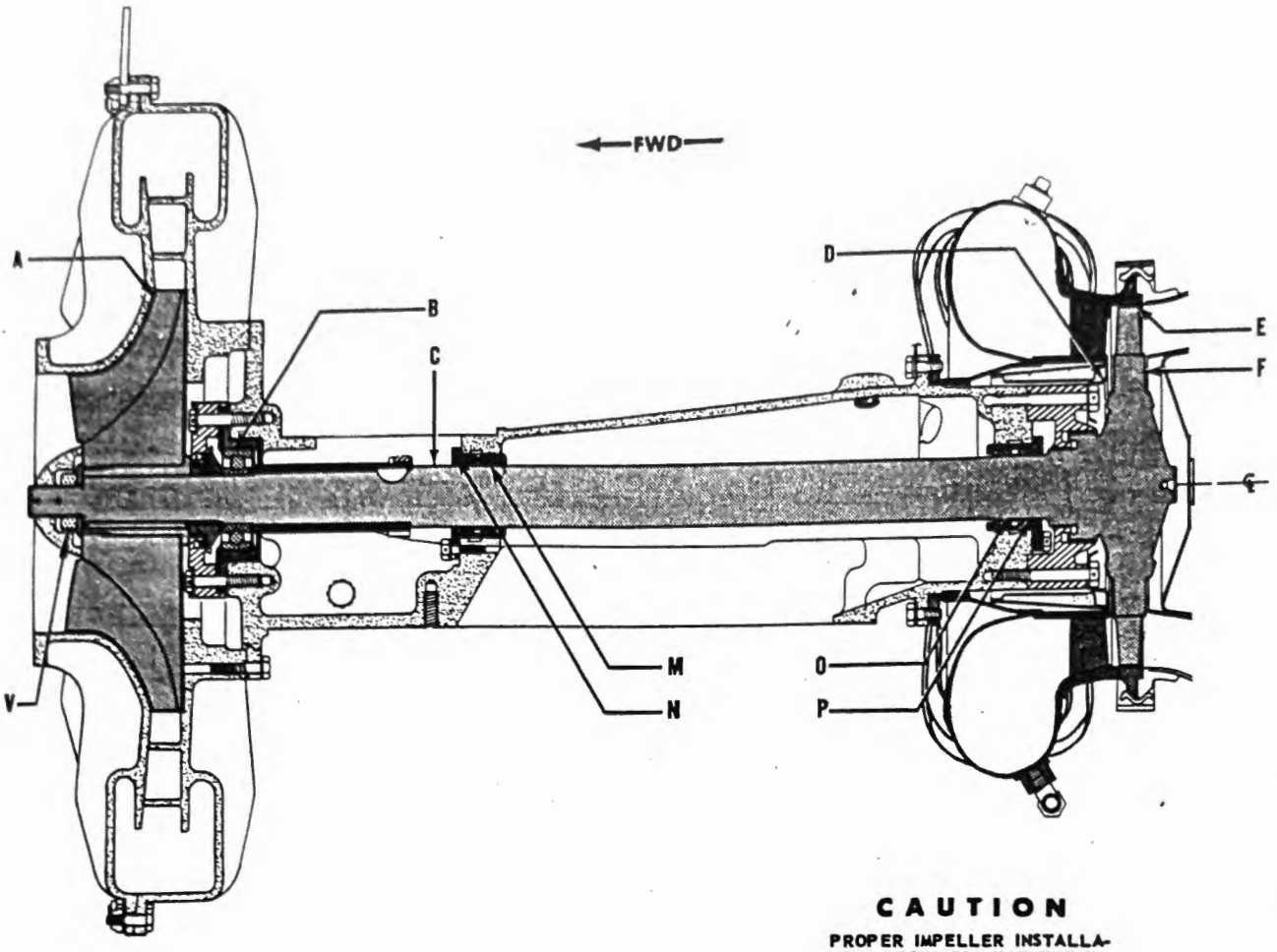
b. Retap hole to same thread size to remove nicks and burrs.

c. Insert new Heli-Coil of same size as damaged coil.

6-36. WELDING BURNER SHELL.

a. Cracks can be repaired by inert tungsten arc welding, using A1S1347 (19-9 Cb stabilized) filler rod. Before welding, the cracked areas should be mechanically cleaned. Repair-welds that will interfere with installation of the seal rings should be ground to original contour. Scrap shell if distorted after welding.

6-37. REPAIR OF IMPELLERS. (See figure 6-1.) Cracks up to 1/16 (.0625) inch in depth in leading edge of vanes (item 12) may be carefully ground out by smoothing and blending the grind along entire leading edge of vane. Cracks not exceeding .0625 inch in depth on outer edge of vane and on wheel periphery (item 16) may be ground out by fairing and polishing grind area. Reject impeller if any cracks are found to exceed 1/16 (.0625) inch in depth. Metal build-up



CAUTION

PROPER IMPELLER INSTALLATION REQUIRES THAT THE IMPELLER HUB EXTEND BEYOND THE SHOULDER ON THE SHAFT AND THAT THE IMPELLER WASHER REST ON THE THREADS OF THE SHAFT AS SHOWN.

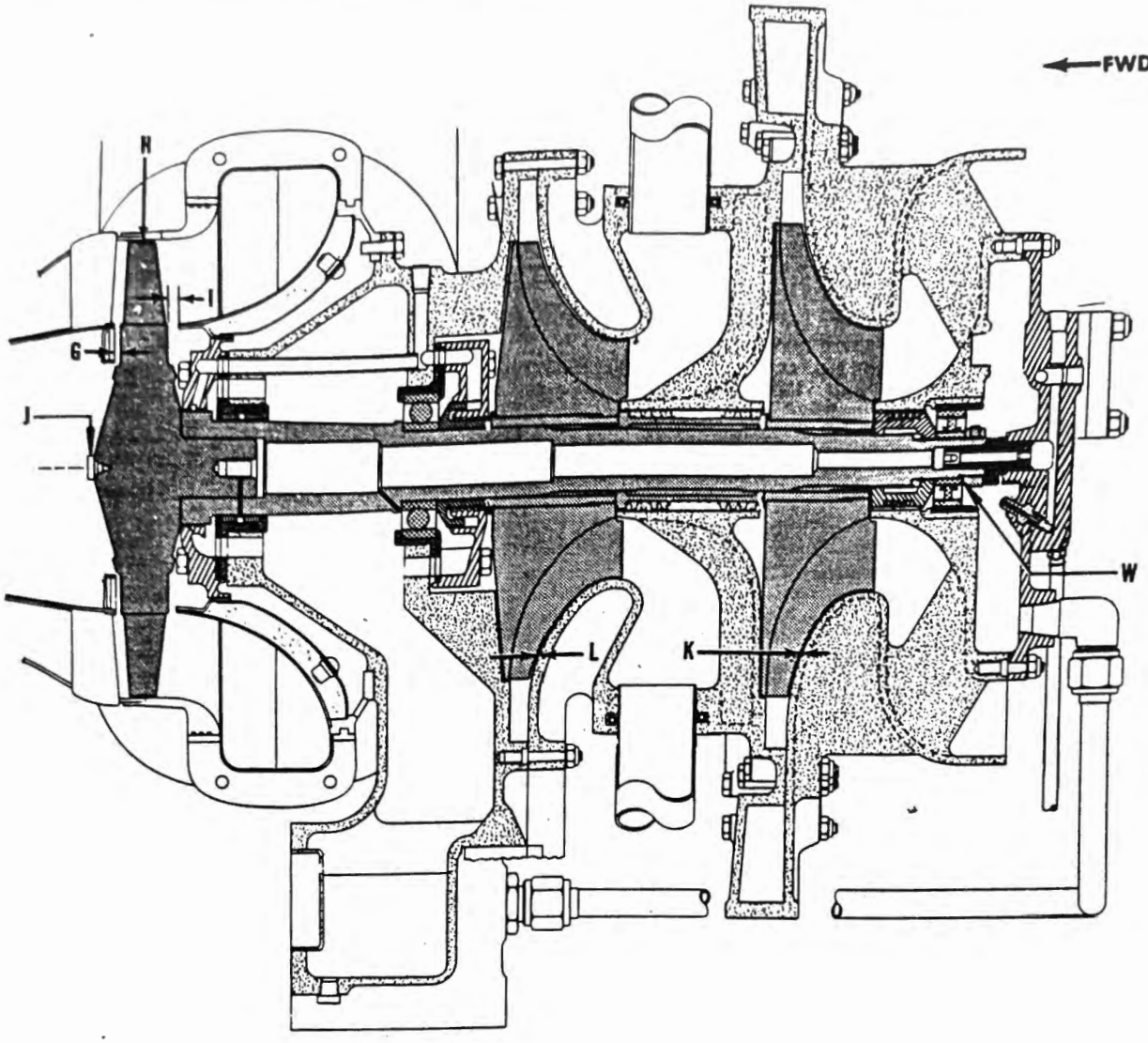
NOTE

CLEARANCES MEASURED COLD

CLEARANCES

ITEM	NOMENCLATURE	LOCATION	SERVICE MINIMUM	SERVICE MAXIMUM
A	Impeller	to compressor front case with impeller held forward	0.025 in.	0.040 in.
B	Compressor bearing	to bearing retainer	-	0.0003 in.
C	Rotor shaft	concentricity (runout)	-	*0.0005 in.
D	Turbine wheel	to air deflector	0.080 in.	-
E	Turbine wheel	radial clearance	0.015 in.	
F	Turbine wheel	to nozzle ring	0.020 in.	-
G	Turbine wheel	to inner shroud	0.160 in.	0.190 in.
			0.120 in.	Engine 336 and on 0.120 in.
				Engines 278 - 283
H	Turbine wheel	radial clearance	0.025 in.	%/0.040 in.
I	Turbine wheel	to inner cone	0.060 in.	
J	Rotor shaft	concentricity (runout)	-	*0.0010 in.

FIGURE 6-5. ENGINE CLEARANCES (Sheet 1 of 2)



CLEARANCES

ITEM	LOCATION	NEW PART MINIMUM	NEW PART MAXIMUM	SERVICE MAXIMUM
K	Impeller to rear housing	0.025	0.035	0.035
L	Impeller to center housing	0.025	0.035	0.035
M	Center bearing to main rotor shaft	.0020 in.	.0032 in.	.0052 in.
N	Center bearing to bearing retainer	.0037 in.	.0054 in.	.0074 in.
O	Turbine bearing to main rotor shaft	.0020 in.	.0032 in.	.0052 in.
P	Turbine bearing to bearing retainer	.0033 in.	.0050 in.	.0070 in.

#	Insufficient clearance occasionally can be corrected by rotating the nozzle box 180 degrees
/	To obtain proper radial clearance, it may be necessary to machine the nozzle ring outlet concentric with the turbine wheel diameter
%	Some loss of power will result from increased turbine wheel blade clearance, especially in gas producer section
*	Total indicator reading
**	0.015 minimum when new nozzle box is installed and 0.010 on overhaul

FIGURE 6-5. ENGINE CLEARANCES (Sheet 2 of 2)

can be removed by grinding and polishing to the original surface.

NOTE

Entire balancing assembly must be rebalanced after any grinding on impeller. (Refer to paragraphs 6-37, 6-48, 6-49, 6-50 and 6-51.)

6-38. REPAIR OF WHEEL AND SHAFT ASSEMBLIES. Cracks not exceeding 1/16 (.0625) inch in depth may be ground out provided no more than .0625 inch of metal measured from leading or trailing edge is removed from any one blade. Grinding must extend along entire length of blade to uniform depth and smooth contour of blade, particularly rounded off leading edge, must be maintained. Rebalancing is required after grinding.

TABLE VII. TORQUE LIMITS

A. STANDARD TORQUES

Bolt Size	MINIMUM	MAXIMUM
10-32	20 inch-pounds	25 inch-pounds
1/4-28	50	70
5/16-24	100	140
3/8-24	160	190
7/16-20	450	500
1/2-20	480	690

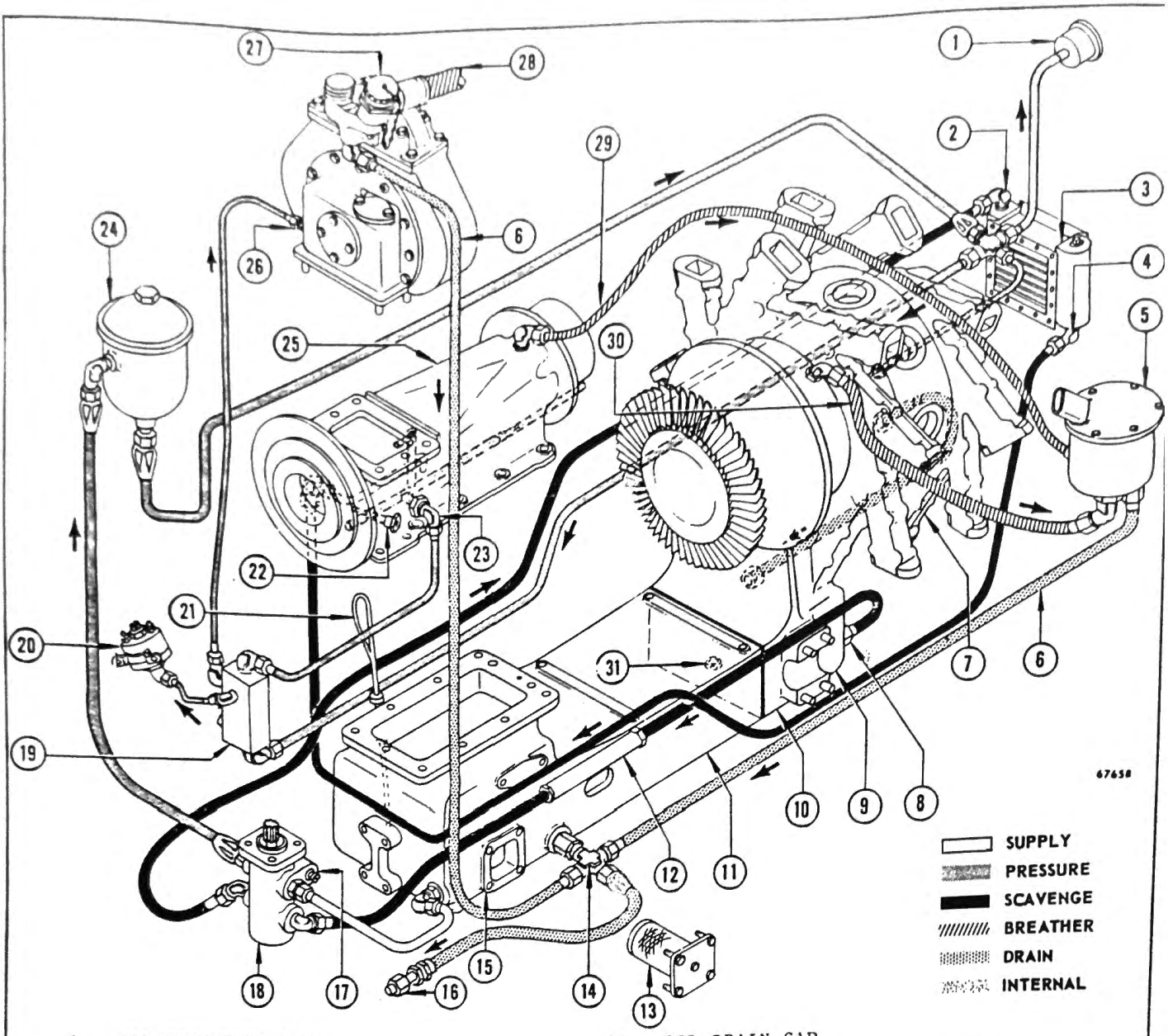
B. MISCELLANEOUS TORQUES

ITEM	MINIMUM	MAXIMUM
Impeller nut (V, figure 6-1)	600 inch-pounds	650 inch-pounds
Nut on two-stage compressor shaft (W, figure 6-1)	750	800
Two-stage compressor mounting nuts (35, figure 4-2)	445	455
Nuts on burner clamps (13, 20, figure 4-9)	55	65
Spanner nuts in accessory drive (16, 47, 69, figure 4-8)	150	190

6-39. REPAIR OF NOZZLE BOX. The nozzle box may be repaired as follows:

a. Cracks in the trailing edge, may be ground out to a smooth contour. (See item 1, figure 6-1). Do not exceed 3/32 inch maximum depth of grind. No repair of cracks in leading edge of vanes should be attempted.

b. Cracks in sheet metal and welds may be repaired by welding, providing no distortion affecting critical clearances results. (See item 2, figure 6-1 and item E, figure 6-5.) All areas to be welded must be mechanically cleaned or degreased prior to welding. Suitable degreasing methods are vapor degreasing or washing the parts in naphtha. When blast cleaning equipment is not available for cleaning, clean with stainless steel wire brush, emery paper or stainless steel wool, or by grinding out with a hand grinder. Use particular care to avoid smearing surface and masking defects.



1. OIL PRESSURE GAGE
2. OIL INLET TO COOLER
3. OIL COOLER RADIATOR
4. OIL OUTLET FROM COOLER
5. BREATHER OIL SEPARATOR
6. BREATHER DRAIN
7. TWO-STAGE COMPRESSOR
8. TWO-STAGE COMPRESSOR SCAVENGE OUTLET
9. TWO-STAGE COMPRESSOR BASE
10. TWO-STAGE COMPRESSOR OIL SUMP
11. GAS PRODUCER BASE
12. SCAVENGE STRAINER
13. SUPPLY RESERVOIR STRAINER
14. OIL SUPPLY DRAIN CROSS
15. ONE GALLON SUPPLY RESERVOIR IN FORWARD END OF GAS PRODUCER BASE
16. OIL DRAIN CAP
17. OIL PRESSURE ADJUSTING SCREW
18. LUBE AND SCAVENGE PUMP
19. OIL MANIFOLD
20. OIL PRESSURE SWITCH
21. DIP STICK
22. BALL BEARING OIL JET
23. PRESSURE INLET PORT FROM OIL MANIFOLD
24. LUBE FILTER
25. ROTOR HOUSING
26. ACCESSORY DRIVE OIL JET
27. OIL FILLER CAP
28. ACCESSORY DRIVE OIL BREATHER
29. ROTOR HOUSING BREATHER LINE
30. TWO-STAGE COMPRESSOR BREATHER LINE
31. TWO-STAGE COMPRESSOR SUMP DRAIN

FIGURE 6-6. LUBRICATION SYSTEM

Sheet metal and weld cracks in the nozzle box may be repaired by inert tungsten arc welding using 310, 312 or Hastelloy W filler rods. As an optional method, metal-arc welding may be used with 1/16 (.0625) or 5/64 (.0781) inch diameter 312 or 19-9 WX electrodes, with an AC-DC type coating. Repair welds that interfere with mating surfaces at installation should be ground to original contours. Fluorescent penetrant inspect repair welds per specification MIL-I-6866. Annealing after welding is unnecessary.

6-40. REPAIRING NOZZLE RING, INNER CONE ASSEMBLY AND EXHAUST COLLECTOR SHELLS. Repair nozzle ring, inner cone assembly and exhaust collector shells as follows:

a. After mechanical cleaning (paragraph 6-39) sheet metal and weld cracks may be repaired by metal-arc welding with 347 ac-dc type electrode, or by inert tungsten arc welding with AISI 347 rod. Grind to original contour any repair welds that will interfere with mating surfaces at installation. Annealing after welding is unnecessary.

b. In repair of vane cracks in nozzle ring, grind each crack to its full depth, but do not exceed 3/32 inch. For repair of cracks by grinding, see figure 6-2. Do not repair cracks in leading edge of vanes.

6-41. STARTER-GENERATOR REPAIR.

a. All parts - replace if defective.

b. Rotor assembly - if necessary, turn commutator up to 0.0005 inch on a side with very light lathe cut. Dress with No. 0000 sandpaper. After turning, face must be concentric with shaft to within 0.001 inch full indicator reading.

c. Wires and terminals - replace as necessary. Use same size wire as found, per specification MIL-W-5086. Use same size terminals. Insulate with glass fiber and vinylite sleeving as required.

6-42. VOLTAGE REGULATOR REPAIR. File contacts with No. 6 American Swiss cut file. Use file parallel and lengthwise to armature. File just enough so contacts present smooth surface toward each other. It is not necessary to remove every trace of burning. After filing, dampen a piece of linen or lintless bond tape in carbon tetrachloride and draw tape between contacts. Repeat with dry piece of tape. Use clean piece of tape for each set of contacts.

6-43. REPAIR OF LUBE AND SCAVENGE PUMP. The relief valve may be repaired as follows:

a. Darkened or discolored area on seat of relief valve, indicative or improper seating, should be polished by turning or lapping in the valve against its seat in the body assembly casting.

b. A galled surface on side of relief valve, indicative of sticking, should be carefully polished with a stone.

6-44. REPAIR OF OIL PRESSURE SWITCH. Loose or broken wire terminals on microswitch may be repaired by thoroughly removing old solder and resoldering terminals.

6-45. REPAIR OF AIR COLLECTOR AND FIRST-AND SECOND-STAGE TUBE ASSEMBLIES. Air collector assembly may be repaired by thoroughly cleaning the area to be welded (instructions for cleaning in Section V) and then inert tungsten arc welding the crack, using 435 filler rod with Neapolitan A.B.C. flux.

6-46. GENERAL REPAIR OR REPLACEMENT. Repair or replace as inspection indicates is necessary.

6-47. ESTABLISHING RUNOUT.

6-48. BALANCING ASSEMBLY RUNOUT CHECK. The required runout of the balancing assembly should be established in the following manner:

a. (See figure 4-10.) Assemble Woodruff key (40), drive pinion (41), ball bearing (42), oil slinger (37), square key (33), impeller assembly (32), impeller nut washer (31), impeller nut (30), and impeller fairing nut (38) on wheel and shaft assembly (39).

NOTE

To prevent excessive runout during assembly of the balancing assembly, carefully wipe all shaft, bore and shoulder surfaces clean of lint and dust particles prior to assembly of the balancing assembly. The importance of this cannot be over-emphasized.

b. Using special tool, Section III, Table II, group five (figure 7-5), torque the impeller nut from 600 to 650 inch-pounds and install the impeller fairing nut (28).

c. Set two "V" blocks on surface plate and support balancing assembly in "V" block; one block supporting ball bearing outer race and other supporting shaft just forward of turbine wheel oil seal.

d. Set up adjustable mount for 0.0001 inch dial indicator, using approximately .064 diameter ball end for dial indicator, to take reading on shaft just behind drive pinion. (See figure 7-7.) Check runout on shaft. Total runout should not exceed 0.0005 inch total indicator reading (T.I.R.).

e. If the total runout exceeds the 0.0005 inch T.I.R. mark impeller nut washer and oil slinger with approved ink at point of highest runout. Rotate washer 180° from its present position and retorque impeller nut. Take new reading with shaft on "V" blocks. From this determine if any further adjustment is necessary. If balancing assembly runout is still beyond tolerance, loosen impeller nut and rotate oil slinger. Repeat above procedure. If, by varying the washer and oil slinger position on the shaft, the acceptable tolerance still cannot be met, disassemble and reclean all bearing surfaces and shoulders of balancing assembly. Stone down any small burrs. Reassemble and recheck runout. If runout tolerance still cannot be met disassemble and exchange one component at a time until defective part is found.

f. When balancing assembly is within the runout limit, locate point at which the highest runout occurs and mark location and total amount of runout in ten-thousandths of an inch, using an electric etching pencil. Mark drive pinion as shown in figure 7-7.

6-49. ROTOR ASSEMBLY RUNOUT CHECK. Two-stage compressor rotor assembly runout should be established in the following manner:

a. Support wheel and shaft assembly on "V" blocks placed under forward and rear shaft journals and set up adjustable mount and 0.0001 inch dial indicator.

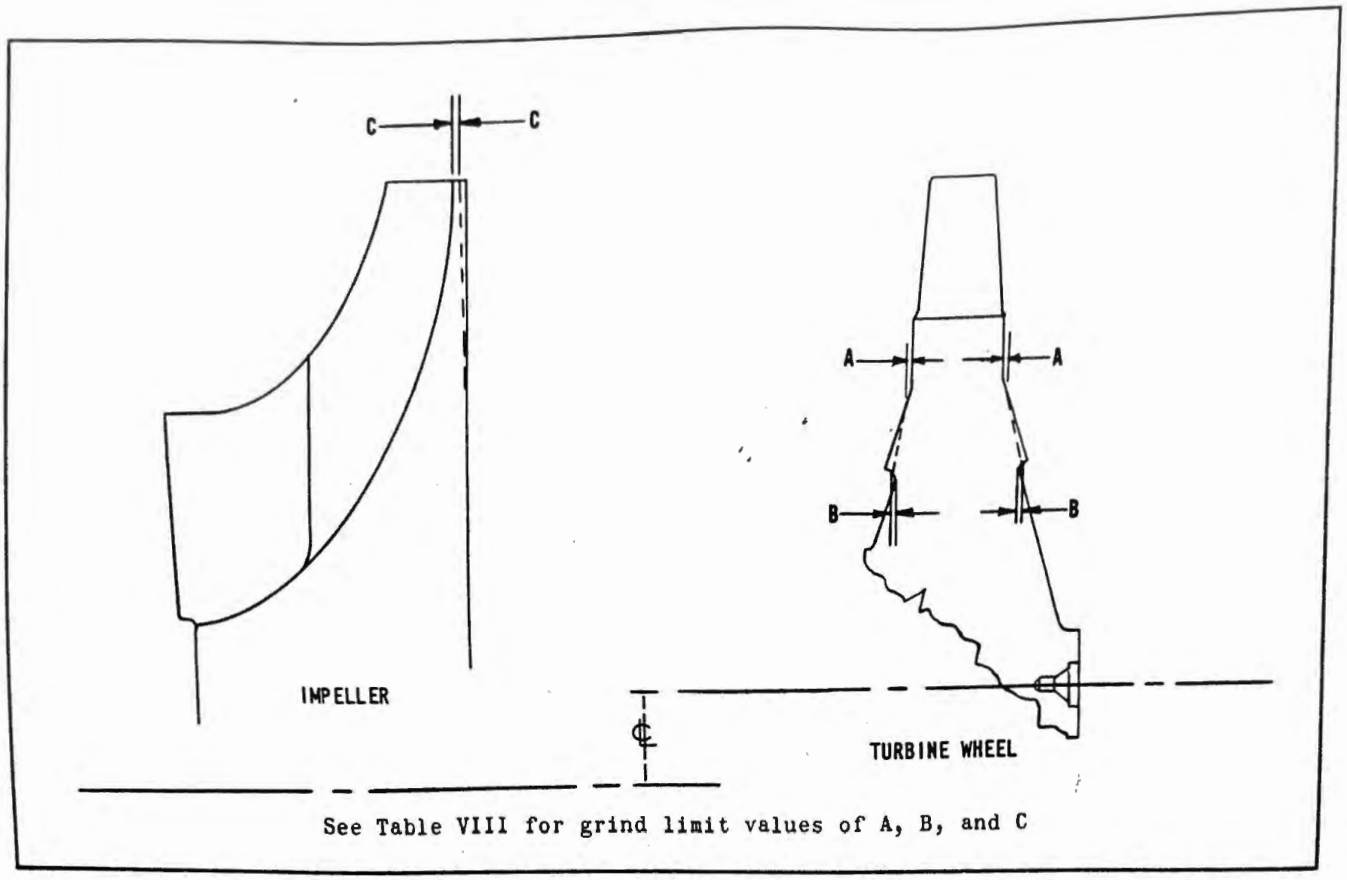


FIGURE 6-7. IMPELLER AND TURBINE WHEEL GRIND LIMITS

Position dial indicator as shown in figure 7-9. Rotate wheel and shaft assembly and note total amount of indicator runout and mark location of point of highest runout.

NOTE

To prevent excessive runout during assembly of the rotor assembly, carefully wipe all shaft, bore and shoulder surfaces clean of dust and lint particles prior to assembly of rotor assembly. The importance of this cannot be overemphasized.

b. Place wheel and shaft assembly in vertical position on improvised stand. Install rotor assembly components on wheel and shaft assembly. When installing the impellers on their splines allow impellers to fall

TABLE VIII. TURBINE WHEEL AND IMPELLER GRIND LIMITS

WHEEL OR IMPELLER	FIGURE 6-7 INDEX	AFTER GRINDING MINIMUM DIMENSION
Balancing Assembly Turbine Wheel	A	0.02 inches
Balancing Assembly Turbine Wheel	B	0.02 inches
Rotor Assembly Turbine Wheel	A	As required, but not below face surface of wheel
Rotor Assembly Turbine Wheel	B	As required, but not below face of wheel
Balancing Assembly Impeller	C	0 13 inches
First-stage Impeller Assembly, Two-stage Compressor	C	0.05 inches
Second-stage Impeller Assembly, Two-stage Compressor	C	0.06 inches

e last 1/8 to 1/4 inch on to spline seat. Do not ve impeller after this operation. Using special ls in Section III, Table II, group nine, torque nut 750 to 800 inch-pounds.

NOTE

Particular care should be taken when torquing nut on end of rotor assembly, not to push against impeller when pulling wrench. It is recommended that a snap-type torque wrench be used. Rotor assembly should not be moved from the vertical position on improvised stand for this operation.

Place the rotor assembly in horizontal position with ll bearing and balancing bearing (balancing bearing places roller bearing in this operation) supported "V" blocks mounted on a surface plate. Set up 0001 inch dial indicator on adjustable mount as shown figure 7-8.

NOTE

Position dial indicator to read runout halfway between wheel stub filler radius and wrench flats on forward face of wheel stub shaft. (See figure 7-9.)

. Rotate wheel and shaft assembly and read total mount of runout. Runout reading must not exceed ie limits of ±0.0005 inch from the reading made in tep "a." If the runout falls within these limits mark ie total indicator reading runout on forward end of ub shaft (figure 7-9) as a single digit representing en-thousandths of an inch. Locate present point of ighest runout and mark on end of stub shaft with two mall punch marks. (See figure 7-9.) Match mark each component in line with two punch marks at end of shaft. Match mark spacers and air seal with arrow pointing toward the threaded end of shaft.

e. If runout does not fall within limits specified in step "d," mark present high runout point with approved ink on each rotor assembly component. Loosen nut and rotate oil slinger 180° from present high point. Torque nut and recheck runout as described in step "d" above. Repeat same process for spacers, oil seals and oil slinger, rotating one part at a time. Torque nut and check runout each time, until runout falls within specified limit. Mark stub shaft and details as described in step "e" above when required runout is obtained.

6-50. BALANCING.

6-51. METHOD AND LIMITS. The manufacturer uses a Gisholt Dynetric balancing machine employing an aluminum adapter to hold the ball bearing and absorb the thrust generated by the rotation of the impeller. The bearing nearest the turbine wheel is supported in a lignum-vitae bearing.

NOTE

Lignum-vitae bearing must be kept clean and well lubricated with oil, grade 1010, specification MIL-O-6081, to prevent scratching of the turbine shaft.

Balance the assembly to within 0.00 to 0.01 ounce-inches. Any removal of material to accomplish balance requirement must be taken from the back side of the impeller assembly and the balancing rings machined on the hub of the turbine wheel. See figures 6-3 and 6-7 for areas where grinding is permitted and for depth limitations on amount of grinding.

SECTION VII

ASSEMBLY OF SUBASSEMBLIES AND ACCESSORIES

7-1. GENERAL.

7-2. The following general instructions apply to the work to be accomplished during assembly of the subassemblies of the engine and accessories.

a. Graphite particles deposited on stainless steel will carburize the steel at high temperatures, destroying its corrosion resisting properties. Do not use lead pencils, grease pencils, or carbonaceous inks for marking hot section parts. Use chalk, soapstone or noncarbonaceous inks.

b. Antiseize compounds which contain zinc should not be used for bolting stainless steel parts as zinc causes rapid and severe corrosion at temperatures above 450°C (850°F). Use MIL-C-5544 antiseize compound (or approved equivalent) for bolting parts that operate at temperatures up to 676°C (1250°F). Zinc plated tools should not be used in working on stainless steel parts of the engine. Stainless steel components will rapidly corrode at temperatures above 450°C (850°F) after being scraped or rubbed by zinc plated tools.

c. All O-rings should be coated with petroleum jelly per Federal specification VV-P-236 prior to assembly. O-rings are very easily damaged during installation, therefore every precaution should be exercised to prevent excessive stretching, nicking or pinching. Do not slide or roll O-rings over threaded surfaces. Threads should be covered with thin paper prior to slipping an O-ring in place over the threads. Damage to O-rings at assembly is not readily apparent, being evidenced only by subsequent leakage or other malfunction. Handling and installing O-rings with more than usual care will result in more reliable operation of the engine.

d. Pipe threads other than those located in the high temperature areas of the engine should be lubricated with fuel and oil resistant grease per specification MIL-L-6032 (or equivalent).

e. The balancing assembly of the gas producer section may have either the woodruff key, square key, fairing nut or ball bearing replaced without requiring complete replacement or rebalancing of the balancing assembly. The required runout tolerance of the balancing assembly however must be re-established upon assembly if new components have been substituted for those listed above.

f. The rotor assembly of the two-stage compressor assembly may have the roller bearing and ball bearings replaced without requiring rebalancing of the rotor assembly. The required runout tolerance must be established upon assembly.

g. High temperature thread lube per specification MIL-C-5544 (or equivalent) should be applied to threads on components located in the high temperature areas of the engine.

h. All lockwire used on the model 502-7D engine should be in accordance with specification MIL-W-6713 (corrosion resistant lockwire, condition A, annealed) and should be installed per Military Standard 33540.

i. Refer to table VII, section VI for torque values to be used in assembly of the subassemblies and accessories.

j. During assembly of the engine and accessories all bearings, bearing surfaces and gears should be lubricated with oil per specification MIL-O-2104 (grade SAE 10).

k. Refer to section III, table II for group listing of special tools required for assembly of the subassemblies and accessories.

l. Prior to assembly, all parts should be visually inspected to be sure they are clean. All bearing surfaces should be wiped with a clean, lint-free cloth and all traces of corrosion preventative compound should be removed.

7-3. BURNER SECTION.

7-4. SPECIAL TOOLS. Refer to section III, table II, group four for special tools required for assembly of the burner section.

7-5. ASSEMBLY. (See figure 4-9.) Assemble each burner assembly of the burner section in the following manner:

a. Install a new fuel nozzle (32) in adapter (29) and install adapter in elbow (31).

b. Install seal ring (23), gasket (21) and clamp (20) over forward end of burner shell (19). Insert forward end of burner shell in groove of burner elbow assembly. Install burner liner (18) in burner shell assembly. Align crossfire tube nipple holes in both burner liner and shell, rotate both parts as a unit until vapor spark plug hole in burner liner aligns with vapor spark plug hole in bottom of burner elbow. Observe that burner shell is down in groove of elbow. Push seal ring and gasket forward and tighten clamp to 60 inch-pounds.

NOTE

Burner clamps should be installed with bolt up and nut away from engine to prevent interference with burner tie bolts.

c. Check downstream position of burner liner assembly within the burner shell. If burner liner is off center, remove liner, bend liner support ring (around rear or downstream end of burner shell assembly) as required to center liner in burner shell.

CAUTION

Burner liner assembly must fit tight and be directly centered within burner shell assembly to prevent heat damage to nozzle box assembly.

d. Install gasket (17) and vapor spark plug assembly (16) in burner elbow, and secure with two washers (15) and two bolts (14).

e. Using handle end of screw driver, and working through aligned crossfire tube nipple holes in burner shell and burner liner, force burner liner towards open end of burner shell until vapor spark plug prevents further movement of burner liner.

CAUTION

Fit of burner liner assembly within burner shell support ring must still be tight.

f. Insert gage, special tool, group four (see figure 7-1) in burner liner assembly to check position of fuel nozzle. Tip of fuel nozzle must protrude into burner liner assembly at least 0.001 inch but not more than 0.040 inch. If fuel nozzle position is not within this tolerance, using special tool, group four determine thickness of shim required. To replace shim, remove vapor spark plug, burner liner and burner shell from burner elbow. Remove adapter from burner elbow and install one shim (30) of the proper thickness (see table IX) as required to adjust position of fuel nozzle.

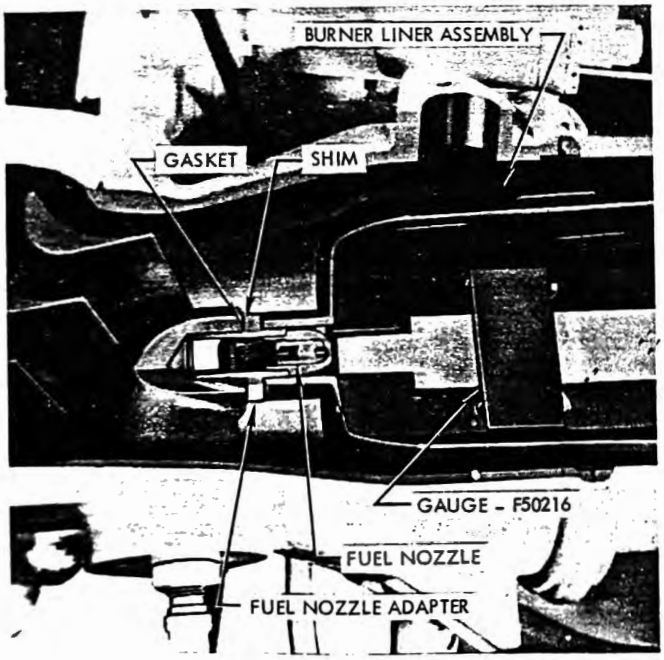


FIGURE 7-1. CHECKING SHIMMING OF THE FUEL NOZZLE ASSEMBLY

TABLE IX. SHIM THICKNESS	
Shim Part No.	Thickness
3-90572	.032 inch
AN901-8A	.051 inch
3-90571-1	.081 inch
3-90571-2	.102 inch
3-90571-3	.125 inch
3-90571-4	.156 inch

g. Using clamp, special tool, group four (see figure 7-2) block off orifice in fuel nozzle. Connect a pressurized source of Stoddard solvent (specification P-S-661b or equivalent) to burner elbow assembly fuel inlet port. Apply 800 psi pressure to burner elbow assembly. There must be no leakage around the fuel nozzle assembly or fuel inlet port of burner elbow assembly. If leakage is present, replace defective parts.

NOTE

Fuel nozzle assemblies must always be checked with gage, special tool, group four before being tested for leakage.

h. Install burner shell, burner liner and vapor spark plug on burner elbow assembly as described in steps b through e above. Install seal ring (22), gasket (21) and clamp (19) over open end of burner shell.

i. Install gasket (28), cover (27), bracket (26) on top boss of burner elbow and secure with two washers (25) and two bolts (24).

7-6. ACCESSORY DRIVE ASSEMBLY.

7-7. SPECIAL TOOLS. Refer to section III, table II, groups six, seven and eight for special tools required for assembly of the accessory drive assembly.

7-8. ASSEMBLY. (See figure 4-8.) The accessory drive assembly should be assembled in the following manner:

a. On oil pump drive spindle (77) press two new bearings (76) firmly against spindle shoulders. Insert spindle and bearings into bearing seats in end cap casting. Place bearing retainer plate (74) in position over threaded end of spindle and secure firmly, using four machine screws (75). Place new gasket (68) and plate (67) on top of end cap and secure gasket and plate using two washers (66), two washers (65) and two bolts (64). Push bronze helical gear, with protruding shoulder toward bearing, over threaded end of spindle and hold firmly against inner race of bearing. Using leaf type feeler gage, check clearance between side of gear and plate. This clearance cannot be less than 0.010 inches. If necessary, remove helical gear and add or subtract shim (73) as required. Install woodruff key (72) in spindle key slot with curved edge in. Align spindle and gear key slots and push bronze helical gear (71) into position. Install new lock washer (70) against helical gear with inner tab of washer in key way of spindle. Using special tool, group eight (see figure 7-3) tighten lock nut (69) on

spindle, using between 150 and 190 inch-pounds of torque. Bend lock washer tabs into lock nut recesses.

b. Place 96-tooth gear (62) on its mounting shoulder on hub of 57-tooth gear (63) and secure tightly with four bolts (61). Shave bolts if they protrude through 96-tooth gear. Stake ends of bolts. Bolt heads may be ground to .110 inch if interference with end cap occurs. Install woodruff key (60) on cluster gear shaft (59) and store in dry ice for 20 minutes. Soak gear assembly (62 and 63) in hot oil bath. If gear is to be heated starting with cold oil, immerse gear in oil and soak until temperature of oil reaches 161°C (290°F). If oil has been preheated to 161°C (290°F) soak for 15 minutes. Remove cluster gear from dry ice and press by hand into large gear bore (63).

NOTE

Determine that key flat is parallel with cluster gear shaft prior to pressing into gear bore.



FIGURE 7-2. PRESSURE CHECKING THE FUEL NOZZLE ASSEMBLY

If shaft starts to seize, press remaining distance with arbor press. Install external retainer ring (58) in groove on cluster gear. Press two new bearings (57) against shoulders on each end of cluster gear. Install 96-tooth gear and 57-tooth gear group, carefully pushing bearing at cluster gear end into bearing seat in accessory drive body. Apply light coat of permatex No. 3 to faying surface of end cap. Secure end cap (37) to body (45) using nine washers (36), nine washers (35) and nine bolts (34). Place laminated brass shim (30) on bearing cap (27) and fit bearing cap over bearing. Secure bearing cap and shim to end cap using four washers (29) and four bolts (28).

NOTE

Progressively tighten bearing cap bolts so as not to cock bearing cap on bearing. Working through bottom of body, check that end play of cluster gear is between .005 inches and .010 inches. If end play is not within tolerance adjust by peeling or adding to laminated brass shim. Lockwire, in accordance with specification MIL-W-6713 of .032 inch diameter, should be installed in accordance with Military Standard 33540 on bearing cap bolts.

c. Install new O-ring (32) in grooved seat on lube jet nozzle (31). Screw jet nozzle into boss on side of end cap until O-ring is seated against cap. Position nozzle so spray is directed vertically upward, and wrench flats are horizontal and "O" mark is on upper wrench flat. Holding jet nozzle in proper position, tighten flared tube nut (33) on nozzle.

d. Install spacer (54) inside of accessory pad (56) and secure in position with internal retainer ring (53) placed in its seat on stud side of accessory pad and with internal retainer ring (55) on opposite side. Drive new neoprene plug (50) into flat end of 81-tooth gear (49) so plug is flush to .05 inch below surface of gear. Press bearing (51) onto shoulder of 81-tooth gear. Insert gear shaft through accessory drive pad from side opposite studs. Press bearing (52) over gear shaft until tight against shoulder. Install new lock washer (48) and using special tool, group seven (see figure 7-3), hold gear in lead or copper jawed vise and tighten lock nut (47) using between 150 and 180 inch-pounds of torque. Bend lock washer tabs into lock nut recesses. Push bushing (46) into its seat in accessory drive pad. Place 96-tooth gear and 57-tooth gear group in position in top of body, carefully meshing gears. Coat faying surface of cover with permatex No. 3. Install accessory drive cover (44) in position on top of body. Secure cover, using four washers (43), four new lock washers (42) and four bolts (41). Insert bolts through the raised bosses at center of cover. Secure corners of cover to body using four washers (40), four lock washers (39) and four bolts (38). Secure governor drive accessory pad to body and cover using six washers (26), six lock washers (25) and six bolts (24).

e. Install spacer (22) inside the tachometer generator accessory pad (23) and secure in position by installing two internal retainer rings (21) in grooves in accessory pad. Press bearing (19) tight onto shoulder of 81-tooth gear (18). Press gear and bearing into seat in accessory drive pad from side opposite studs. Press bearing (20) onto shoulder of projecting end of gear shaft. Install new lock washer (17) over shaft. Using special tool, group six (see figure 7-3) and with gear held in vise having copper or lead jaws, torque lock nut (16) to between 150 and 190 inch-pounds. Bend lock washer tabs into lock nut recesses. Coat faying surface of tachometer generator accessory pad with permatex No. 3. Install tachometer generator accessory pad assembly in accessory drive body, carefully meshing gears, and secure fimrly to body using twelve washers (15), twelve lock washers (14) and twelve bolts (13). Place new gasket (12) over studs and against accessory pad.

f. Drive plug (9) into gear end of output gear shaft. Carefully meshing gears, insert shafts of output gear (8) and input gear (7) in bearings in tachometer drive accessory pad. Secure output gear retaining group using two gear retainer spacers (6), retainer plate (5), two new special lock washers (4) and two bolts (3). Bend tabs of lock washer against flats of bolts and edges of plate. Insert bushing (10) in its seat in accessory pad. Install tachometer drive pad assembly (11) on studs of tachometer generator pad assembly and carefully mesh input gear with 81-tooth gear. Firmly secure gasket and two pad assemblies together, using eight washers (2) and four nuts (1).

7-9. SUMP AND BASE SECTION.

7-10. ASSEMBLY. (See figure 4-13.) The sump and base section should be assembled in the following manner:

a. Place manifold bracket (19) in position, flanged face out and forward, against its mounting pad. With washer (22), clamp (23) and spacer (24) slipped onto bolt, screw bolt (21) through bracket into rear mounting hole in oil sump and base assembly (25). Place remaining washer on bolt (20) and screw bolt through manifold bracket (19) into forward mounting hole in oil sump and base assembly.

b. Screw plug (18) (if required for this assembly) into strainer and slip new oil strainer gasket (17) onto strainer against mounting face. Insert strainer into oil strainer cavity and with all bolt holes aligned, secure strainer assembly (13) to sump using four washers (16), four washers (15) and four bolts (14).

c. Place three washers (12) and three washers (11) on three bolts (10) and secure controller support bracket (9) and attach to sump.

d. Slip gasket (8) over threaded end of dip stick fitting and screw fitting (7) securely into its boss in right side of sump. Insert dip stick assembly (6) into fitting.

e. Place second-stage heat shield (5) on top of sump, with flanged edges down and overlapping top of sump, and secure rear of heat shield with two bolts (1), two washers (4), and two washers (3). Place lower heat shield (2) on top of second-stage heat shield so that bolt holes align with forward bolt holes of second-stage heat shield. Secure both heat shields to sump with two washers (3) and two washers (4) installed between heat shields and with two bolts (1).

7-11. ROTOR SECTION.

7-12. SPECIAL TOOLS AND EQUIPMENT. Refer to section III, table II, groups two, three, five and ten for special tools required for assembly of the rotor section. The following equipment is required for assembly of the rotor section:

a. 0.0001 inch dial indicator

b. Torque wrench of at least 700 inch-pound capacity or 60 foot-pound capacity.

7-13. ASSEMBLY. (See figure 4-10.) Assemble the rotor section in the following manner:

NOTE

It is recommended for convenience that the rotor housing be installed on the oil sump and base assembly prior to assembly of the rotor section.

a. Assemble O-ring (74) over union (72) and thread into right side of rotor housing (73). Working through opening in top of rotor housing, assemble scavenge return tube assembly (71).

b. Secure nameplate (68) to top center of rear compressor casing by installing two screws (69) and two washers (70).

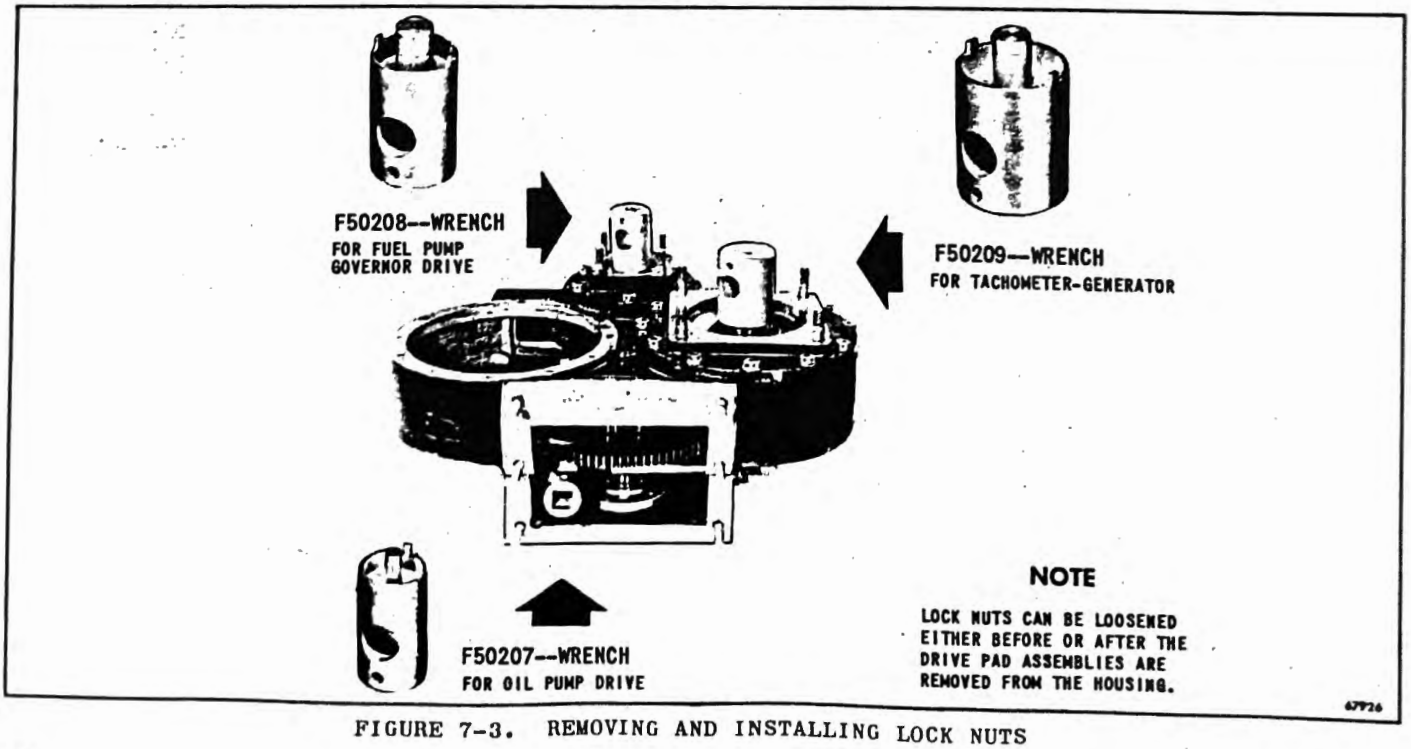


FIGURE 7-3. REMOVING AND INSTALLING LOCK NUTS

c. Assemble one 0.010 inch thick full circle shim (67) over studs on rear compressor casing. Install compressor casing (66) on forward flange of rotor housing and secure with eight washers (65), one nut (64) at top right location and seven nuts (63).

d. Assemble the floating bearing (61) in the bearing retainer (62) and lubricate with oil per specification MIL-O-2104, grade SAE 10. Working down thru opening in top of rotor housing, install bearing retainer in position, assemble retainer plate (60) and secure with four bolts (59). Lockwire bolts per specification MIL-W-6713 with .034 inch diameter lockwire in accordance with Military Standard 33540.

e. Assemble floating bearing (57) into bearing retainer (58) and lubricate with oil (MIL-O-2104, grade SAE 10). Install in rear end of rotor housing. Install retainer plate (56) and secure with four bolts (55). Lockwire bolts per specification MIL-W-6713 with .034 inch diameter wire in accordance with Military Standard 33540.

f. Coat both sides of bearing retainer gasket (54) with high temperature lube per specification MIL-C-5544 (or equivalent) before installation and install bearing cap and oil seal assembly (53) on rear of rotor housing so that oil drain passage at bottom and air passages at sides are aligned with corresponding passages in rotor housing.

g. Install first-stage heat shield (50) and nozzle box (49) in position and secure with eight washers (48) and eight bolts (47).

h. Install the insulating ring assembly (46) and air deflector (45) and secure air deflector, insulating ring, bearing cap and oil seal assembly and bearing retainer gasket to rotor housing with six bolts (44). Lockwire bolts per specification MIL-W-6713 with .034 inch diameter wire in accordance with Military Standard 33540.

NOTE

Air deflector must not touch inner cone of nozzle box at any point.

i. Install plug (51) in top of nozzle box and special elbow (52) in bottom of nozzle box. Coat pipe threads on these parts with high temperature lubricant per specification MIL-C-5544 (or equivalent) prior to installation.

NOTE

Nozzle box drain elbow (52) installed at bottom of nozzle box should point toward right side of engine.

j. Disassemble a previously balanced balancing assembly and insert wheel and shaft assembly (39) from rear of rotor housing through the two installed bearings. Hold wheel end of wheel and shaft assembly to prevent its being forced rearward from the rotor housing during remaining assembly procedures.

CAUTION

To prevent excessive runout, be sure to wipe all traces of dust and lint from the bearing surfaces and shoulders of the shaft. The importance of absolute cleanliness cannot be overemphasized.

k. Working through hole in top of rotor housing, hold pinion (41) in position and push shaft through the pinion, Install woodruff key (40) in slot in shaft and align slot in pinion to receive key. Push wheel and key forward into pinion.

l. Place new, clean ball bearing (42) in bearing retainer (43) and heat bearing and retainer for approximately five minutes in clean oil per specification MIL-O-2104, grade SAE 10 at a temperature of 105°C (220°F).

m. Install bearing and retainer over threaded end of wheel and shaft assembly and insert retainer in bore of rotor housing. Using special tool, group two (see figure 7-4) pull wheel and shaft assembly forward to seat ball bearing inner race against forward end of pinion.

n. Rotate wheel and shaft assembly so that match mark near gear teeth of pinion (see figure 7-7) is at top.

o. Position retainer plate (38) so that holes in plate align with those in bearing cap and housing.

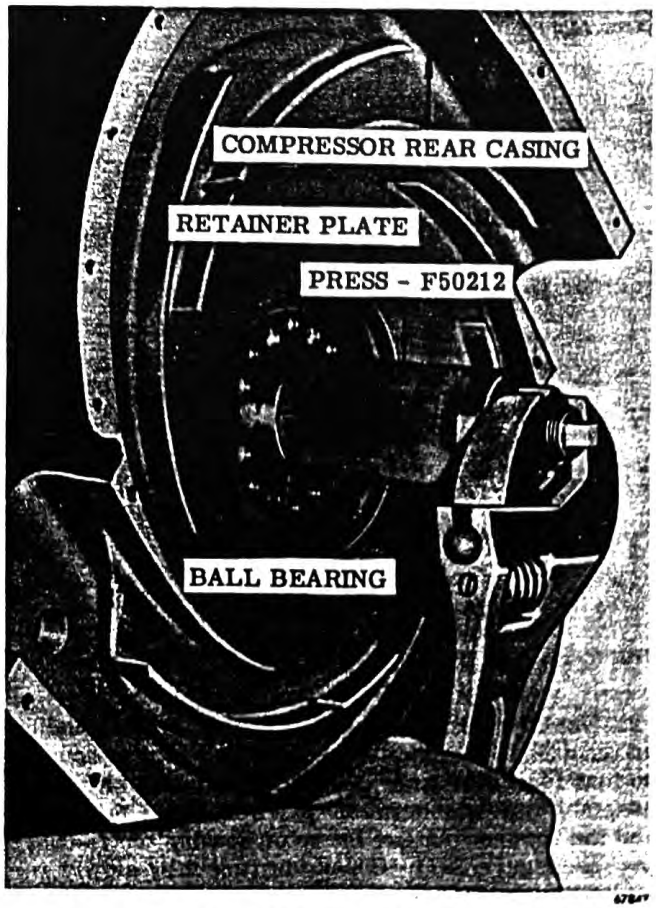


FIGURE 7-4. INSTALLING BALL BEARING IN THE ROTOR SECTION

CAUTION

If the inner edge of bearing retainer plate is beveled, the bevel must face forward (away from the bearing). Reverse installation will permit end play in the rotor shaft and may result in the impeller contacting the forward half of the compressor case.

p. Position oil slinger (37) on wheel and shaft assembly with chamfered face toward bearing retainer so that match mark on oil slinger aligns with match mark on pinion.

q. Install bearing cap (36) over oil slinger and retainer plate so that "TOP" mark on bearing cap is positioned at top. Secure with eight washers (35) and eight bolts (34). Lockwire bolts per specification MIL-W-6713, using .034 inch diameter wire in accordance with Military Standard 33540.

r. Install square key (33) in slot on forward end of wheel and shaft assembly (32). Install special tool, group five (see figure 7-5) on forward face of impeller. Install washer (31) and impeller nut (30).

NOTE

Impeller nut must run freely on shaft threads so that runout reading will not be affected.

Using a torque wrench, tighten impeller nut to a torque range of 600 to 650 inch-pounds or 50 to 54 foot-pounds. Remove special tool.

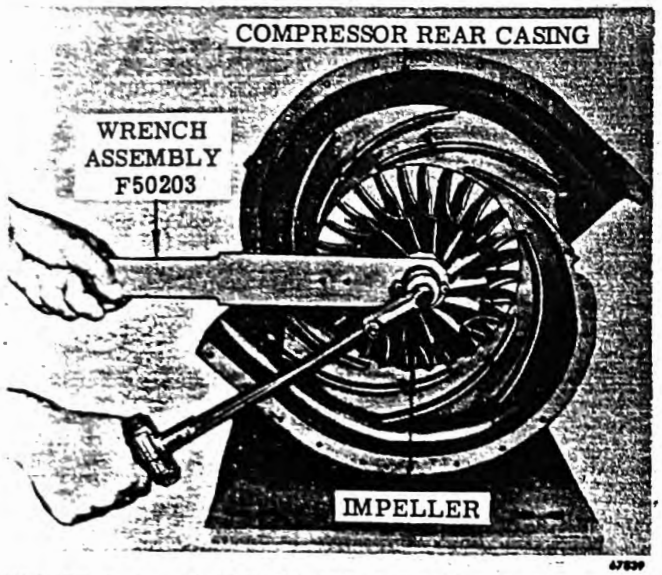


FIGURE 7-5. REMOVING AND INSTALLING IMPELLER NUT

s. Working through opening in top of rotor housing, attach a 0.0001 inch dial indicator to the rotor housing so that indicator arm contacts the wheel and shaft assembly midway between the rear end of the pinion and the retainer plate of the rotor housing center bearing (see figure 7-7). Check the runout by slowly rotating the turbine wheel and shaft assembly. Runout must not vary more than ± 0.0002 inch total indicator reading from value marked on threaded end of wheel and shaft assembly or on pinion.

NOTE

This value is indicated by one digit. For example, a "3" indicates a previously established runout of 0.0003 inch.

The high point of the runout, now being checked, must fall within ± 45 degrees of the previously established runout high point as indicated by two small punch marks on threaded end of wheel and shaft assembly or pinion. (See figure 7-7.)

NOTE

If previously established runout and runout high point are not marked as described above, the runout must not exceed 0.0005 inch total indicator reading.

t. If runout still exceeds established limits, loosen impeller nut (30) and reposition washer (31). Install special tool, group five and retorque nut. Recheck runout and runout high point as described in step s above.

u. If runout still exceeds established limits, remove impeller nut (30), washer (31), impeller assembly (32) and oil slinger (37). Clean hub of impeller assembly thoroughly along bore and mating shoulders. Clean oil slinger as above to remove all traces of lint or dust. Install oil slinger (noting match marks), impeller assembly, and carefully cleaned washers. Install and torque impeller nut, recheck runout and runout high point, as described in step s above.

v. When proper runout and runout high point limits have been achieved, install impeller nut cotter key (29). Install impeller fairing nut (28), using special tool, group three. (See figure 7-6.) Install cotter pin (27) through shaft and impeller fairing nut.

w. Install compressor forward casing (66) and secure with 17 bolts (22), washers (21) and nuts (20). Install hoist fitting (16) at top center of compressor case and secure with three bolts (19), washers (18) and nuts (17). Install two igniter coil brackets (10) and (11), and secure with four bolts (14), four spacers (15), four washers (13) and four nuts (12). Install the four stay bolts (25), washers (24) and nuts (23).

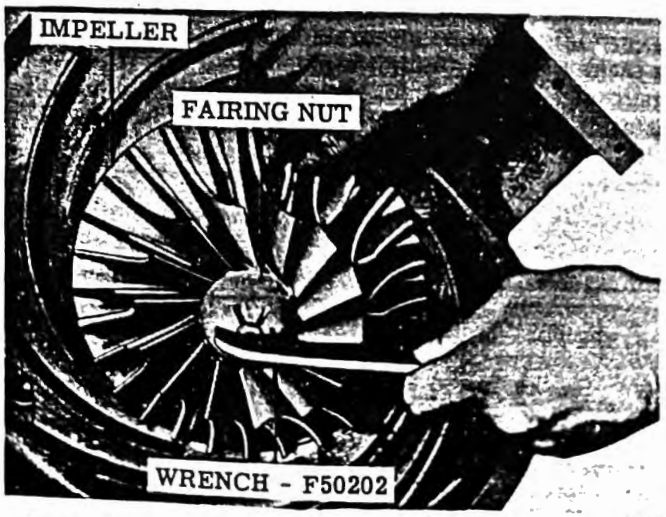


FIGURE 7-6. REMOVING AND INSTALLING IMPELLER FAIRING NUT

x. Using a 0.025 inch diameter wire as a "go" gage and a 0.040 inch diameter wire as a "no go" gage check clearance between vanes on impeller assembly and compressor forward casing. Clearance must fall within 0.025 inch and 0.040 inch. If clearance does not fall within the acceptable range, determine amount of additional shims (67) required and loosen the eight nuts securing the rear compressor case to the forward flange of the rotor housing (see step c) and add split type shims (67) as required. Retighten the eight bolts.

y. Assemble ignition coils (6) to brackets (10) with four bolts (9), washers (8) and nuts (7).

z. Assemble nut (3) and O-ring (5) on end of elbow (4) and install elbow in tapped boss in right side of rear compressor case. Install elbow (2) in tapped boss on right rear of rotor housing. Install compressor to rotor housing tube assembly (1).

7-14. TWO-STAGE COMPRESSOR ASSEMBLY.

7-15. SPECIAL TOOLS AND EQUIPMENT. Refer to Section III, Table II, group nine, for special tools required for assembly of the two-stage compressor assembly.

a. 0.0001 inch dial indicator.

b. V-blocks to support rotor assembly.

7-16. ASSEMBLY. (See figure 4-6.) Assemble the output compressor in the following manner:

a. Install two pipe plugs (68) into second-stage housing (69).

b. Place second-stage housing forward side up and install bearing retainer (67), floating bearing (66). Install retainer plate (65) so that eight bolt holes in plate align with those in retainer. (See figure 7-11.) Install bearing cap assembly (64) and secure bearing cap assembly, retainer plate and bearing retainer with eight bolts (63). Progressively tighten bolts. Install lockwire per specification MIL-W-6713 of .032 inch diameter and in accordance with Military Standard 33540.

c. Install inner cone assembly (62) on second-stage housing and secure with 12 bolts (59), lockwashers (60) and washers (61). (See figure 7-11.) Torque range is 60 - 70 inch-pounds.

d. Disassemble rebalanced rotor assembly by removing all parts from wheel and shaft assembly.

NOTE

Do not discard tag attached to rotor assembly. Take new bearings and clean as described in Section V. Clean all parts except bearings thoroughly in solvent per Federal specification P5-661B, and lightly lubricate with clean oil (Specification MIL-O-2104) grade SAE 10.

e. Improvise a means of supporting the wheel and shaft assembly in a vertical position. Wheel and shaft assembly must be supported well enough to allow the

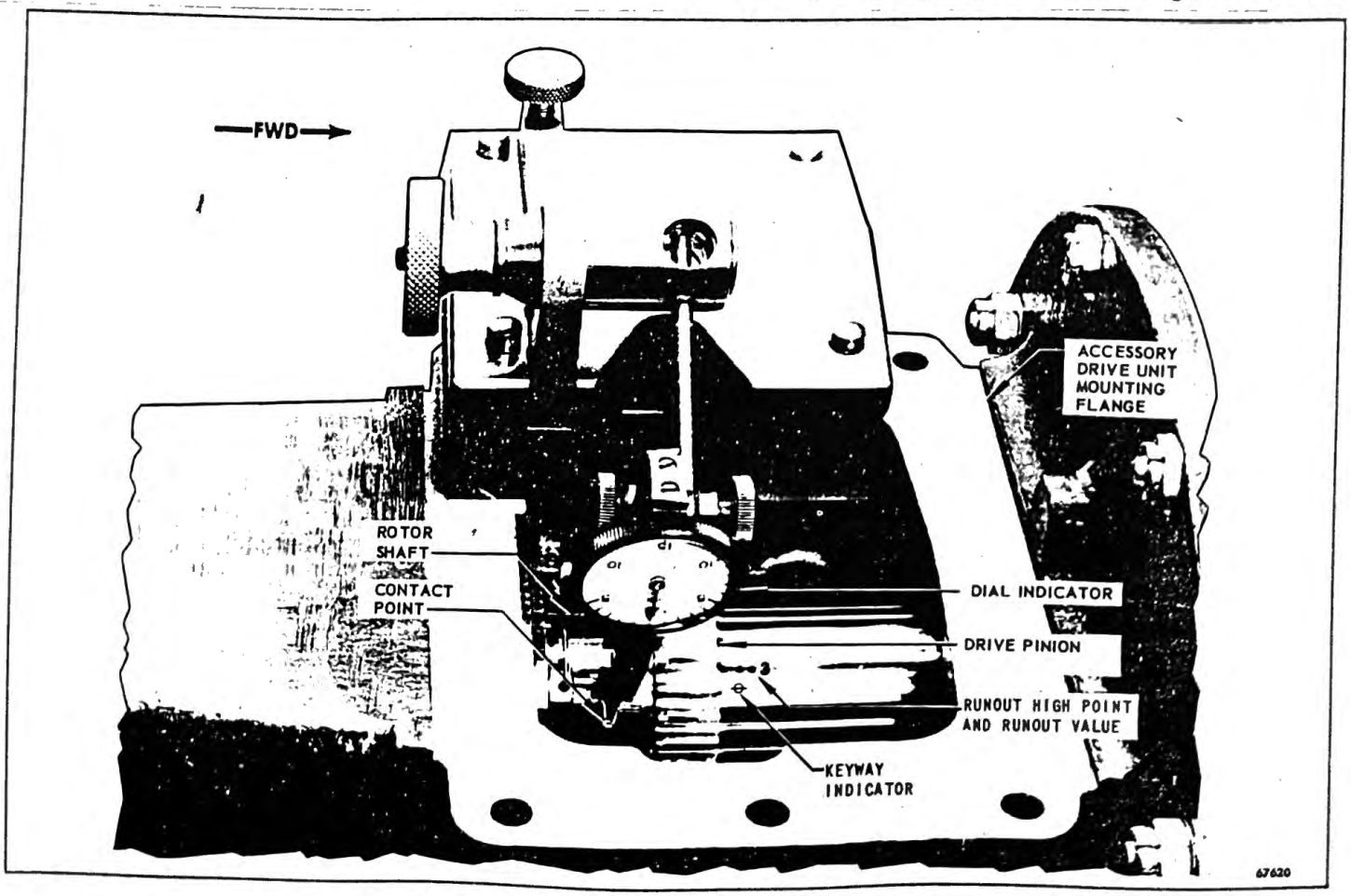


FIGURE 7-7. CHECKING RUNOUT OF BALANCING ASSEMBLY

whole compressor section to be built up on the shaft. Proper clearance measurements require that the compressor housings be supported by the wheel and shaft assembly. Turn second-stage housing so that inner cone side is down and slip housing over wheel and shaft assembly, being careful not to damage floating bearing. Block lower case so that housing will not turn during buildup.

CAUTION

The necessity for detail parts of the rotor assembly being absolutely clean and free of any dust particles on the mating surfaces at the time of installation cannot be overemphasized. A speck of lint or dust between any of the mating surfaces will usually result in a rotor runout beyond acceptable limits. Surfaces and shoulders of the following parts are particularly vulnerable: wheel and shaft assembly, oil slingers, spacers, interstage air seal, impellers and bearing inner races.

f. Install bearing retainer (57) in second-stage housing. Install ball bearing (56), in bearing retainer. Install retainer plate (55) so that bolt holes in plate are aligned with those in bearing retainer and second-stage housing (see figure 7-12). Install oil slinger (54) so that match mark aligns with match mark on threaded end of wheel and shaft assembly. Install spacer (50). Use spacer that was on balanced rotor assembly when disassembled in step d. Make sure that match mark on outer edge is aligned with match mark on oil slinger. Install bearing cap assembly (53) over the spacer and oil slinger, making sure that the position of the match marks has not been disturbed. Secure bearing cap assembly, retainer plate and retainer by progressively tightening eight bolts (51) and washers (52). Lockwire bolts per specification MIL-W-6713 with .034 inch diameter wire in accordance with Military Standard 33540.

g. Using a standard feeler gage check to determine that clearance between forward edge of inner cone assembly and rear face of turbine wheel is a minimum of 0.060 inch. If clearance is below minimum, the inner cone should be removed and the forward edge machined back as required.

h. Install second-stage impeller assembly (49) and air seal (48) on wheel and shaft assembly. (See figure 7-13.) Place a 1/8 inch diameter ball of soft clay on each of four equally spaced full length vanes on impeller assembly. Place interstage housing (47) in position on second-stage housing and locate by two stay bolt holes.

NOTE

Weight of interstage housing will compress clay between housing and second-stage impeller assembly so that a clearance measurement can be made.

i. Remove interstage housing from second-stage housing. Using a sharp knife or razor blade, trim each compressed ball of clay vertically and at right angles to the vane. Use a feeler gage to measure thickness of each piece of clay. Clearance between impeller blades and interstage housing must be between 0.025 and 0.035 inch.

j. If clearance does not fall within limits, remove interstage air seal (48), second-stage impeller (49) and spacer (50). Compute the thickness of spacer necessary to provide correct clearance between the impeller and housing. Select proper spacer (provided as extras with each new rotor assembly) and install this spacer, second-stage impeller and interstage air seal on wheel and shaft assembly. Recheck clearance as described in steps h and i above.

k. If clearance now checks within limits, remove air seal and second-stage impeller. Making sure parts are clean (see CAUTION, step e) carefully check position and direction of match mark on spacer to align with match mark on threaded end of wheel and shaft assembly.

NOTE

Match mark arrows are to point toward threaded end of shaft.

Install second-stage impeller on spline, using care to align match marks and allow impeller to fall free the last 1/8 to 1/4 inch onto spline seat. Do not move impeller after this operation. Install interstage air seal (checking match marks) and interstage housing. Install two close tolerance stay bolts (33) which align second-stage housing with interstage housing. Do not install washers and nuts at this point.

1. Install spacer (40) that was on balanced rotor assembly when disassembled in step d. Align match mark on outer edge of spacer with match mark on shaft. Arrow must point toward threaded end of shaft. Install first-stage impeller (39) and check that clearance of 0.025 to 0.035 inch exists between impeller vanes and first-stage housing (34). Check with clay as described in steps h, i and j above.

m. Lift first-stage impeller on spline and check position of match marks. Allow impeller to fall free the last 1/8 to 1/4 inch onto spline seat. Do not move impeller after seating. Carefully clean and install slinger (38) with match mark arrow on slinger pointing toward threaded end of shaft. Clean inner race of ball bearing (37) and install on shaft. Clean and install nut (25) using special tools in group nine (see figure 7-10). Torque nut to 750 to 800 inch-pounds.

NOTE

Particular care should be taken when torquing nut on end of wheel and shaft assembly not to push against impeller to obtain leverage when pulling wrench. It is recommended that a snap-type torque wrench be used. Assembly should remain in vertical position on improvised stand for this operation.

n. If two-stage compressor bushing (36) has been removed from its position in forward face of the first-stage housing, press in new bushing. Install insert bearing retainer (35) by pressing into rear bore of first-stage housing. Install outer race of roller bear-

ing (37) in bearing retainer and secure with snap ring (27). Secure bearing retainer with retainer key (23) and screw (22) and lockwire screw to tab on key. Lockwire should be installed in accordance with specification MIL-W-6713 and Military Standard 33540.

o. Install first-stage housing over wheel and shaft assembly, taking care not to gouge compressor bushing when fitting compressor case over oil slinger on shaft. Install two close tolerance stay bolts (33) which align the first-stage and interstage housings. Secure compressor housings by installing four washers (32) and nuts (31) on the stay bolts.

p. Remove output compressor section from improvised stand and place on blocks so that rotor shaft is in horizontal position. Check wheel and shaft assembly for runout with a 0.0001 inch dial indicator. (See figure 7-8.)

NOTE

Runout should be checked halfway between wheel stub fillet radius and wrench flats on forward end of wheel stub shaft. (See figure 7-9.)

q. Wheel and shaft assembly runout must not vary more than plus or minus two ten thousands (± 0.0002) inch from runout value written on tag accompanying rotor assembly.

NOTE

If tag giving runout for rotor assembly has been lost, or if turbine wheel and shaft assembly is not coded on the end of stub shaft, the maximum runout should in no case exceed one thousandth of an inch (0.001).

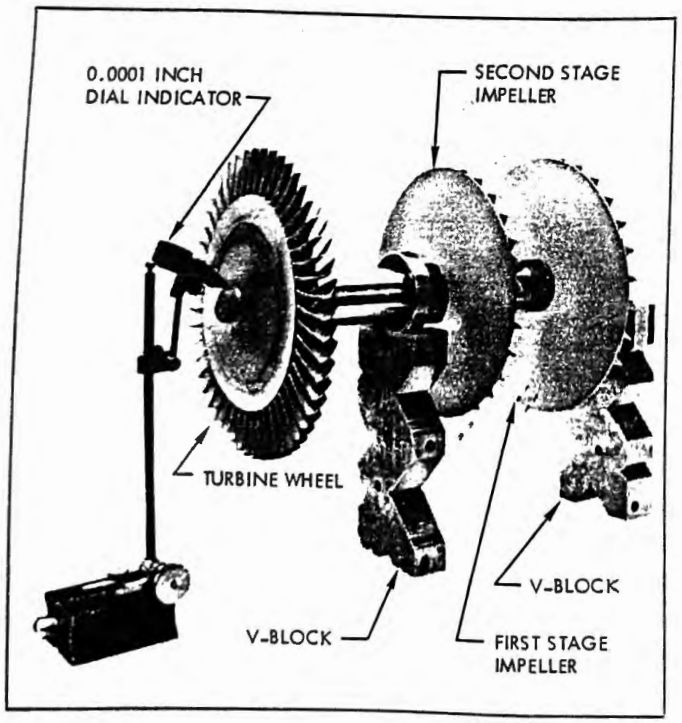


FIGURE 7-8. CHECKING ROTOR ASSEMBLY RUNOUT ON V-BLOCKS

r. High point of new runout reading must fall within ± 45 degrees of runout high point as indicated by two small punch marks on face of stub shaft on forward side of wheel and shaft assembly.

s. If amount of runout and runout high point do not fall within these limits, disassemble the output compressor section as described in paragraph 4-22. Inspect all parts for dirt or burrs. Remove burrs and wipe all bearing surfaces clean.

NOTE

During disassembly of output compressor section, mark any unmarked spacers and bearings with approved ink to align with match marks on end of wheel and shaft assembly.

t. Place wheel and shaft assembly in a vertical position on improvised stand. Install each part of the rotor assembly in its proper position on the wheel and shaft assembly, making sure that position and direction of all match marks align with master match mark on threaded end of wheel and shaft assembly. Torque nut to 750 to 800 inch-pounds.

NOTE

All cautions and notes pertaining to cleanliness and installation procedures previously mentioned in this paragraph apply here in build-up of the rotor assembly.

u. Place assembled rotor assembly in horizontal position with the ball and roller bearing races supported in V-blocks. Check runout as described in steps q and r above. If runout and runout high point fall within specified limits, disassemble rotor assembly, wipe all mating surfaces clean and assemble output compressor section as described in steps e through p above. It is not necessary to recheck impeller clearances again. Recheck runout per steps q and r above.

v. If amount of runout and runout high point do not check in step u above, use approved ink and mark present high runout point on each of the details of rotor assembly. Loosen nut and rotate oil slinger (38) 180 degrees from present high point. Torque nut and recheck runout as described in step u above.

w. Repeat step t for spacers, air seals and oil slinger, rotating one part at a time, torquing the nut and checking runout each time, until runout falls within specified limit.

NOTE

Do not change position of first-stage impeller on wheel and shaft assembly when re-establishing runout. Second-stage impeller may be changed, but this should only be done as a last resort.

x. When proper runout has been established, remove old approved ink marks and remark with approved ink all parts to align with master match mark on threaded end of wheel and shaft assembly. Assemble output compressor section as described in steps e through q above, except after torquing nut on end of wheel and

shaft assembly. Prior to installing first-stage housing, install locking slug (26) in nut (25) and secure with set screw (24).

y. Install rear hoist fitting (46) and secure with three bolts (44), washers (42) and nuts (41). Install 30 bolts (43), washers (42) and nuts (41) to secure interstage compressor housing to the second-stage housing. Secure first-stage housing (34) to interstage housing, using 41 bolts (30), 41 washers (29), and 41 nuts (28).

z. Assemble the accessory drive housing assembly by installing bearing (19), oil jet (18) and pipe plug (17) into the accessory drive housing (20). Apply thread lube as per specification MIL-L-6032 (or equivalent) on pipe threads.

aa. Slip shaft adapter (21) into end of wheel and shaft assembly. Press a small ball of soft clay on the shoulder of the adapter. Install accessory drive cover on first-stage housing. Tighten cover on housing by installing four nuts on studs. Remove nuts and accessory drive cover and measure thickness of flattened clay on shoulder of adapter. End play between shoulder of adapter and bearing not to exceed 0.006 inch.

CAUTION

Clean adapter shaft and bearing to remove clay. Particular attention should be given to oil passages.

bb. Install accessory drive cover assembly on studs in first-stage housing and secure with 12 washers (16) and 12 nuts (15).

cc. Coat eight new silicone rubber gaskets (14) with thin film of petroleum jelly, per Federal specification VV-P-236, prior to installing in grooves of interstage housing. Carefully insert first-stage tube assemblies (12) through silicone gaskets, taking care not to cut gasket. Install eight new gaskets (13) between the first-stage housing and tubes. Secure with 16 washers (11), lockwashers (10) and bolts (9). Install eight second-stage tube assemblies (7), eight new gaskets (8) and secure with 16 washers (6), lockwashers (5) and bolts (4). Slip eight clamps (2) over ends of second-stage tubes and install eight new tube connector sleeves (3) over tubes and secure with clamps. Install air collector assembly (1) with eight clamps (2) over air collector inlet tubes and insert into tube connector sleeves. Secure by tightening eight clamps.

7-17. AIR FLOW CONTROL ASSEMBLY.

7-18. SPECIAL TOOLS AND EQUIPMENT. No special tools are required for assembly of the air flow control assembly. For testing of the air flow control assembly, the following special equipment is required. (See figure 7-14.)

a. Supply of moisture-free compressed air at a pressure not less than 90 psi.

b. Functional test board equipped with four air pressure gages, Kollsman Model 838K-3-011-3044 or equivalent.

c. Three pressure regulator valves.

d. Tubing, fittings and hose assemblies.

e. Two air filters (Wilkerson Valve Inc. Model 1002).

7-19. ASSEMBLY. (See figure 4-5.) The air flow controller should be assembled in the following manner:

NOTE

During assembly all gaskets and the threads of all tube assembly fittings should be given a light coat of antiseize compound, specification MIL-T-5544. Also, prior to installation, all O-rings should be coated with petroleum jelly Federal specification VV-P-236.

a. Hold disc (70) inside check valve housing (71) so its shaft hole lines up with two holes in housing. Insert shaft (69) through holes. Place two washers (68) on two bushings (67) in holes in housing to secure ends of shaft. Secure bushings to housing with six screws (66) and lockwire screws per Specification MIL-W-6713 and Military Standard 33540.

b. Insert gasket (72) between check valve assembly and venturi expander making certain that assembly number on top of check valve body lines up with center of bypass valve hole in top of venturi expander. Secure check valve assembly and gasket to venturi expander (73) with twelve bolts (63), twelve washers (64) and twelve washers (65).

NOTE

Use sufficient washers with three top bolts to prevent bolts interfering with free movement of disc in check valve housing.

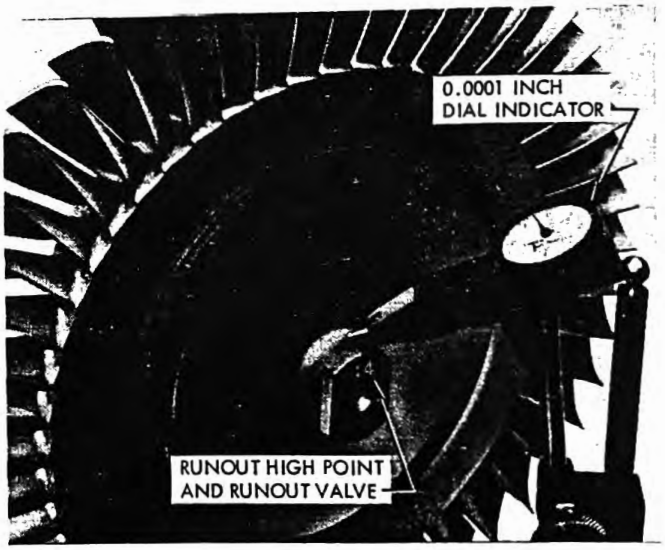


FIGURE 7-9. CHECKING ROTOR ASSEMBLY RUNOUT

c. Place gasket (62) between throat and venturi expander and, with bosses on throat and expander lined up, fasten throat (58) to venturi expander with eight bolts (59), eight lock washers (60) and eight washers (61).

d. Screw stud (54) into piston (55) until holes line up, then lock in position with pin (53). Insert valve (52) through exhaust port of bypass valve body (56). With valve boss up insert piston assembly through valve and secure with washer (51) and nut (50).

e. Insert gasket (49) between valve body and cover and line up all screw holes so that the center line axis of the elbow boss on top of cover is displaced clockwise approximately 67° from the center line axis of the bypass valve exhaust port. Secure the gasket and cover (44) to the body with eight washers (48), eight washers (47), eight washers (46) and eight machine screws (45).

f. Install bypass valve assembly on venturi expander in the following manner: Insert gasket (57) between the expander connecting boss and the bypass valve assembly and line up all bolt holes so that the center line of the valve assembly exhaust port (facing throat) is displaced approximately 28 degrees clockwise from the center line of the venturi expander. Secure bypass valve assembly and gasket to venturi expander with eight washers (43), eight washers (42) and eight bolts (41).

NOTE

Use washers as required to prevent bolts from bottoming in boss of venturi expander.

g. To facilitate assembly of diaphragm section of brain assembly, the following procedure is recommended: Procure twenty washers, part number AN970-3, ten bolts, part number AN3-10A, and ten nuts, part number AN364-1032. Place one washer on each bolt and insert bolts through the bolt holes of diaphragms (25) and separator (24). Inside shoulder of separator should be up. Insert stem (28) through washer (27), plate (26) and through center hole of diaphragms. Place spacer (23) with flanged end down on stem. On top of spacer and separator, and over ten bolts, place three diaphragms (22) and install ten washers and nuts. Tighten nuts enough to prevent diaphragms from rotating when stem nut is tightened. Apply film of antiseize compound per specification MIL-T-5544 to threads on stem. Place plate (21), washer (20) and nut (19) on stem and torque to one hundred inch-pounds. Remove the ten nuts and bolts and twenty washers.

h. Place O-ring (17) on spring anchor (16). Attach extension spring (18) to stem and to spring anchor. Invert diaphragm section with extension spring and spring anchor attached and lower spring anchor into inverted brain cap (15) until spring anchor projects through top of cap. Screw lock nut (11) on spring anchor.

i. Install O-ring (37) on needle (36) and screw needle into brain base (38) and lock with jam nut (35). Place two O-rings (34) in grooves on poppet cage and secure poppet cage (33) to brain base with three washers (32) and three screws (31). Place compression spring (30) on spring guide of poppet cage. Drop poppet (29) into poppet cage with shoulder of poppet resting against spring.

j. Lower brain cap and diaphragm section of brain assembly to brain base, so that axis of elbow boss on brain cap is located 54° counterclockwise from the axis of needle. Secure brain assembly to brain base with ten bolts (14), twenty washers (13) and ten nuts (12).

k. Press four bushings (39) into holes in plate and attach brain assembly and plate to venturi expander with four washers (10), four washers (9) and four bolts (8).

l. Install 45° elbow (7) into boss in brain base. Install two nipples (6), one in brain base opposite 45° elbow and one in throat. Install five 90° elbows (5) as follows: two in throat, one in brain base, one in boss on top of bypass valve cover and one in brain cap. Install four tube assemblies: Bypass valve to brain base (4), throat to brain adapter (3), throat to brain base (2) and throat to brain cap (1).

7-20. TESTING. (See figures 7-14 and 7-15.) The air flow control assembly should be tested after overhaul in the following manner:

a. Connect air flow controller to a functional test board consisting of three pressure regulators, four pressure gages (Kollsman Model 838K-3-011-3044, or equivalent) and two air filters, (Wilkerson Valve Inc. Model 1002) as shown in figure 7-14.

b. Connect a moisture-free supply of air at a pressure of at least 90 psig and reasonably free from pressure fluctuation.

c. Check pressure regulators No. 1, No. 2 and No. 3 for ambient pressure by rotating the control knob of each regulator counterclockwise until loose.

d. Turn control knobs of pressure regulators No. 2 and No. 3 clockwise to obtain simulated upstream pressure readings of 110 in.Hg. absolute on gages No. 2 and No. 3. 27.05 37.85

e. Observe piston pressure on gage No. 4. Reading should be within 85-107 in.Hg.abs. The drop in pressure across the needle valve orifice is due to air bleed at the piston and may be varied by needle valve adjustment. Counterclockwise rotation of needle

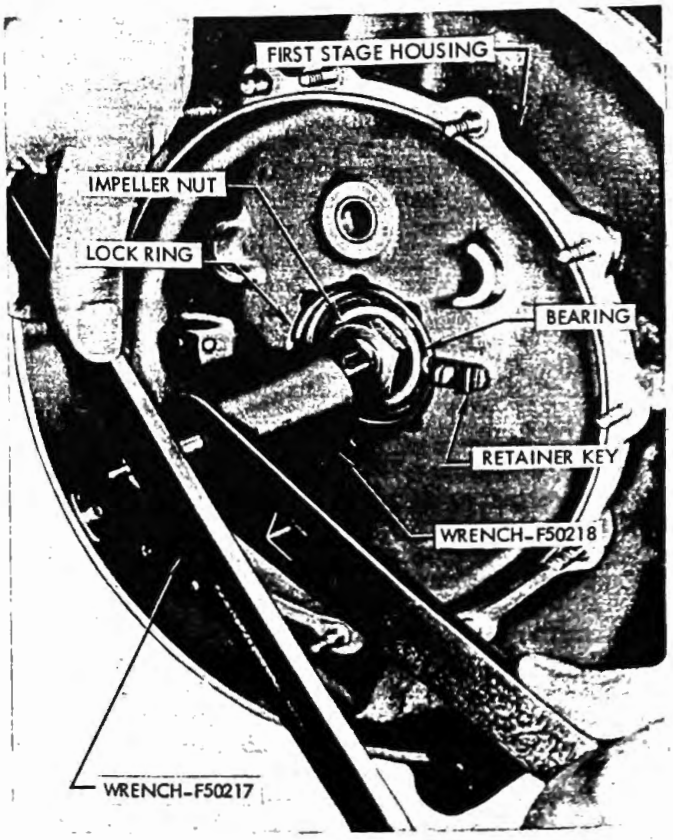


FIGURE 7-10. REMOVING AND INSTALLING NUT ON ROTOR ASSEMBLY

increases piston pressure. Adjust as required to bring reading within acceptable limits.

f. Open pressure regulator No. 1 to increase simulated throat pressure on gage No. 1 until initial opening of the poppet valve is indicated by a sudden drop in pressure on G-3 and G-4.

g. Maintain 110 in.Hg.abs. on gage No. 3 with pressure regulator No. 3 while continuing to increase throat pressure with pressure regulator No. 1 until the piston pressure reading on gage No. 4 drops to 66.0 in.Hg.abs. Throat pressure reading on gage No. 1 at this point should be within 87.3-88.7 in.Hg.abs. Throat pressure may be altered by varying the pressure ratio adjustment. Counterclockwise rotation of adjustment nut increases throat pressure. Record reading on gage No. 1.

h. Check and record throat pressure readings on gage No. 1 for upstream pressure settings on gage No. 2 and gage No. 3 of 90, 70 and 50 in.Hg.abs. with piston pressures on gage No. 4 at 56.9, 47.7 and 38.5 respectively. Corresponding throat pressures on gage No. 1 should be 71.3-72.7, 55.3-56.7 and 39.3-40.7 in.Hg.abs. as shown on chart, figure 7-15.

i. Alter pressure ratio adjustment as required to bring throat pressure readings within acceptable limits.

j. If the air flow controller cannot be adjusted to the prescribed limits, the unit should be rejected.

7-21. STARTER-GENERATOR.

7-22. SPECIAL TOOLS AND TEST EQUIPMENT. No special tools are required for assembly of the starter-generator.

a. To test the starter-generator as a motor, an electrical power source of 24V dc and a test stand capable of loading the output gear to 70 inch-pounds torque is required.

b. To test the starter-generator as a generator, a voltage regulator, ammeter, starter switch, 24V dc battery and a means of driving the output gear at 5,400 rpm speed is required. See figure 7-16 for test diagram.

7-23. ASSEMBLY. (See figure 4-20.) The starter-generator should be assembled in the following manner:

NOTE

Ball bearings should be packed with grease, specification MIL-G-3278. During assembly, apply a very thin film of grease, specification MIL-G-3278, to the threads of the commutator end of the rotor assembly.

a. Install brush springs (44) on brush holder assembly (40). Wind springs to provide a load of 2 pounds 12 ounces, on brushes. Install brush holder assembly in end bell (45). Use conducting segments (38) across the grounded brush boxes, and insulating segments (39) across hot brush boxes.

b. Install terminal studs (15 and 17) on stator leads. Install lead and terminal on stud (16). Install the end bell assembly on stator assembly (58). Bring common stator lead through end bell to meet one terminal of hot brush box. Install stud (16) and bring its lead to meet terminal of opposite hot brush box. Install wire lead (35), and two terminal straps (36) between two brush boxes.

c. Install insert (13), and terminal base (12). Install insulators (5, 8, and 11) on the terminal studs, and secure with nuts (4, 7, and 10).

d. Install ball bearings (56 and 57) on rotor assembly (54). Install oil seal (52) in end plate (51). Install sleeve (55). Install plate (51). Use one shim (53).

e. Install gear (48). Use as many shims (50) as required to position gear outward to prevent any interference with plate (51), then use as many shims between gear and retaining ring (49) as required to reduce end play of gear to minimum possible.

f. Install the complete rotor assembly in stator assembly (58). Use as many shims (30) as required to reduce end play of rotor assembly to 0.010 inch. Install bearing retainer (27), and ground strap (26). Connect ground strap between two grounded brush boxes. Use one terminal strap (36) on each brush box.

g. Install plate (25), and fan (22). Install fan cover (20).

h. Install brushes (18). After tests have been completed, install side cover (1).

7-24. TESTING.

a. NO LOAD TEST AS A MOTOR. Apply 20V dc to the terminal studs. Operate without load until the brushes have seated 100 per cent.

b. DI-ELECTRIC TEST. While the starter-generator is still warm from no load test, disconnect shunt field, and remove two grounded brushes. Apply 500 volts, alternating current (ac) root-mean-square (rms) 60 cycles per second (60 cps) for one minute between the terminal studs and ground. There must be no flashover, or evidence of breakdown of the insulation.

c. LOAD TESTS AS A MOTOR. Apply 20V dc to the terminals of the motor. Load the output shaft with the loads listed in Table X. The amperage draws and speeds must be those listed in Table X with the motor at a temperature of 20°C to 50°C (78°F to 122°F).

TABLE X
AMPERAGE DRAW

TORQUE LOAD (inch-pounds)	AMPERES (± 10 per cent)	SPEED (rpm)
20	44	2600
30	62	2400
40	75	2150
50	94	1970
60	110	1800
70	130	1600

d. TEST AS A GENERATOR. Connect the starter-generator in a test circuit as diagrammed in figure 7-16. Drive the output gear through a speed range of 6000 to 10,000 rpm. With no load and with full field, the generator must deliver 27 volts dc.

7-25. FUEL PUMP AND GOVERNOR ASSEMBLY.

7-26. SPECIAL TOOLS AND EQUIPMENT. No special tools are required for assembly of the fuel pump

and governor assembly. For testing the fuel pump and governor assembly the following special equipment is required (see figure 7-17):

a. Two fuel pressure gages reading to 1000 psi.
b. One fuel pressure gage reading to 60 psi.
c. Varidrive for driving fuel pump and governor assembly up to speeds of 3400 rpm.
d. Rotometer to measure fuel flow up to 300 pounds per hour.
e. Valves and tubing as required.
f. Supply of fuel, specification MIL-F-5624A (JP-4).

7-27. ASSEMBLY. (See figure 4-14.) The fuel pump and governor should be assembled in the following manner:

a. Insert two body bearings (102) (see sheet 2) into seats in body assembly (103). Insert driven gear (100) in body bearing in blind cavity and insert drive gear (101) in open body bearing. Place two body bearings (99), flat sides together, over shafts of drive and driven gears and install seal pin (98) between flat sides of body bearings.

b. Install seal rings (97), two wafer springs (95), two spring spacers (96) and two more wafer springs (95) on shoulders of body bearings.

c. Install seal ring (92) in cover inner face. Position mating surfaces of body assembly and cover together and drive two taper pins (88) through mating flanges. Attach cover (89) to body assembly with four washers (91) and four screws (90).

d. Place gasket (94) on plug (93) and screw plug in drain boss on top of cover. Lockwire plug in accordance with MIL-W-6713 and Military Standard 33540.

e. Insert spring (87) into splined end of drive gear. Mate splines and install coupling (86) over drive gear.

f. Install diaphragm assembly (85), diaphragm guide (84) and stop (82) over external splines of drive gear. Place washer (83) into diaphragm guide so inner tabs rest in recesses in diaphragm guide and outer tabs engage in recesses in stop. Place washer (81) against washer (83) and install large end of spring (80) inside thrust plate. Place small end of spring against washer.

g. Align screw holes in diaphragm assembly, stop, and thrust plate (78) and secure to cover, using four screws (79).

h. (See sheet 1.) Install O-ring (76) in body and install O-ring (75), needle valve (74) and nut (73) in top of body (77). Place O-ring (72) on check valve plug and install check valve plug (71) in top of body. Lockwire needle valve and check valve plug per specification MIL-W-6713 in accordance with Military Standard 33540. Place O-ring (70) on plug and insert plug (69) into side of body. Press new restriction (68) into lower face of body until its outer end is flush with inner edge of O-ring seat. Insert O-ring (67) in seat.

i. Reassemble differential relief valve into lower part of body as follows: Invert body, place two O-rings (66) on relief valve sleeve assembly and insert sleeve assembly (65) into body. Insert restriction (64) into piston and install small end of relief valve piston (63) into relief valve sleeve assembly. Place shim washer (61) against shoulder on spring guide rod (60), place relief valve spring (62) over rod and insert these parts into relief valve cap. Place O-ring (59) on its seat on cap and install relief valve cap (58), O-ring end first, into body against relief valve piston. Lock relief valve cap in place with retaining ring (57). Place seal ring

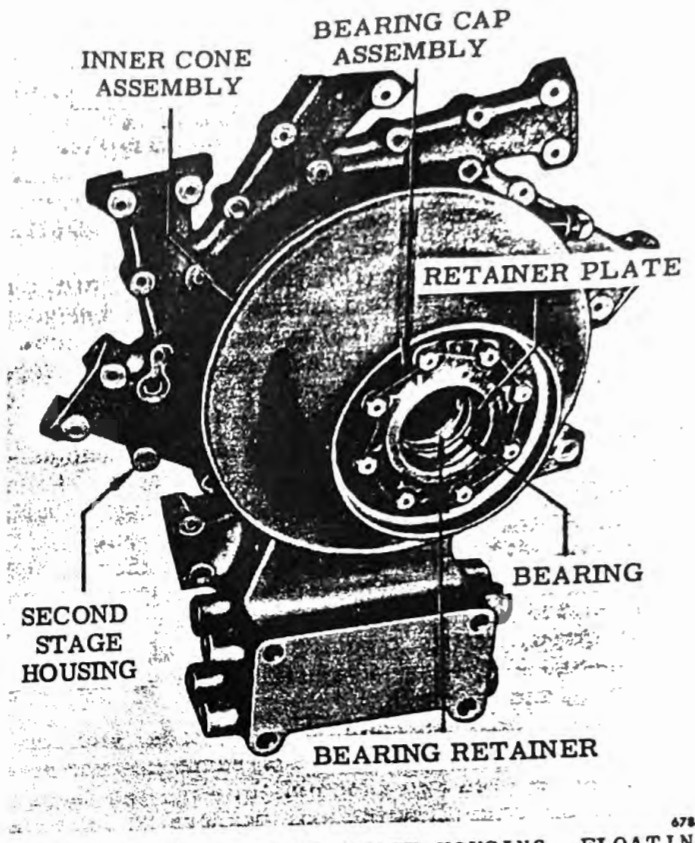


FIGURE 7-11. SECOND-STAGE HOUSING, FLOATING BEARING AND CAP ASSEMBLY INSTALLED

(50), wide side first, into recess into back side of base and secure base (47) to body with three washers (49) and three screws (48).

j. Reassemble the ballhead group as follows: Insert four bushings (44) into two flyweights (45) and place flyweights against ballhead so that pin holes are aligned. Hinge two flyweight assemblies to ballhead by inserting two flyweight pivot pins (43). Place four washers (42) over ends of pivot pins and lock washers in place with four cotter pins (41). Over threaded end of pilot valve plunger (40) install thrust bearing (39), wide race down, spring seat (38), notched side down, and secure with nut (37). Insert plunger and attached parts into ballhead so that wide race of thrust bearing rests on flyweight arms. Holding ballhead vertically, snap wide end of speeder spring (36) into spring seat so that projecting end of coil, which is bent out, fits into slot in spring seat. Insert two filister head screws (33) thru ballhead cup (34) and thru two ballhead cup spacers (35).

k. Insert ballhead group in body so that splined end of ballhead (46) protrudes thru face of body. Over ballhead place thrust washer (32) and lock in place with retaining ring (31). Place torsion drive spring (29) into drive coupling assembly (30) and install on ballhead with notched end of drive coupling up. Push small end of spring drive adapter assembly (28) into exposed end of spring and lock with spring retainer ring (27) so that it seats in grooves in drive coupling assembly and spring drive adapter assembly. On speed adjusting shaft (26) place O-ring (25). Insert drive pin (24) and slide speed adjusting worm (23) onto shaft. Screw speed adjusting worm into cover so upper

speeder spring seat (22) can be slipped on to the threaded end of speed adjusting shaft. Tighten new nut (21) on speed adjusting shaft.

l. Insert cover gasket (20) between cover (17) and body and insert speed adjusting shaft and attached parts into body so upper speeder spring seat snaps into small end of speeder spring projecting through hole in ballhead cup. Align bolt holes and attach cover and gasket to body with six washers (19) and screws (18). Lockwire screws per specification MIL-W-6713 in accordance with Military Standard 33540.

m. Position stop ring (16), flat surface inward, on cover boss so that scribed marks match, and secure in position with washer (13) and screw (12). Install nuts (15) on stop screws (14) and position on stop ring. Install retaining ring (11) in seat on cover boss against stop ring. Slide control lever stop (10) over splines on shaft so that scribed marks in end of speed adjusting shaft and outer surface of stop ring match. Push control lever stop inward until its inner surface is flush with inner end of splines on speed adjusting shaft. Secure control lever stop on shaft with washer (9) and screw (8). Install speed adjusting lever (7) on splines on shaft, and position at angle that will prevent lost motion throughout its angular movement from idle to high speed. Secure speed adjusting lever on shaft with washer (6) and screw (5).

n. Position governor on fuel pump studs, with governor and pump fuel inlet ports on same side and new gasket (4) between two assemblies, align and secure governor to pump (1) using four washers (3) and four castle nuts (2).

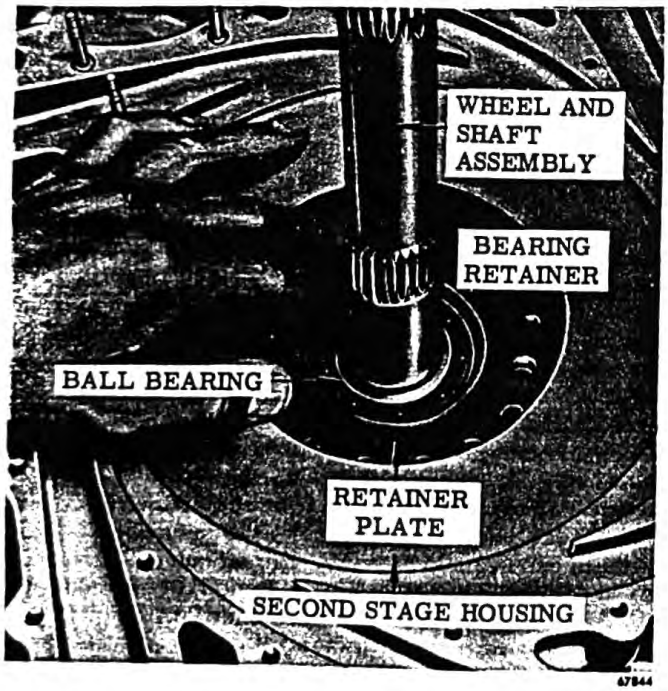


FIGURE 7-12. ALIGNING BEARING RETAINER AND PLATE IN SECOND-STAGE HOUSING

7-28. TESTING. The fuel pump and governor assembly should be tested in the following manner:

a. Conduct all tests in a room where ambient temperatures are controlled between 18.3°C (65°F) and 35°C (95°F). No leakage is permitted from the fuel pump and governor assembly except at the pump drive shaft. Leakage at the shaft should not exceed seven drops per minute or seven cubic centimeters per 30 minutes.

b. Connect fuel lines between fuel pump and governor assembly and test stand as follows (see figure 7-17):

T-1 - connect to governor outlet
T-2 - connect to fuel pump outlet
T-3 - connect to fuel pump inlet

c. Check fuel discharge capacity with valves positioned as shown below:

1. V-1 - open
   V-2 - closed
   V-5 - open
   V-6 - adjust to maintain fuel supply pressure between 0 psi and 3 psi
2. Run governor between 3080 and 3090 rpm and adjust governor speed control lever and valve V-1 to position which will give a minimum fuel flow rate of not less than 350 pounds per hour at 400 psi as measured on gage G-2.
3. Stop rotation of fuel pump and governor assembly before proceeding to next operation.

d. Check starting pressure in the following manner:

1. Position valves on test bench as shown below:
   V-1 - closed
   V-2 - open
   V-3 - open
   V-4 - open
   V-5 - open
   V-6 - Adjust to maintain fuel supply pressure between 0 psi and 3 psi.
2. Set governor speed control lever against high speed stop and run unit between 400 and 410 rpm. Gradually close valve V-3 until flow stops, or until 400 psi is reached, whichever occurs first. If 400 psi is reached first do not close valve any further; record the flow. Discharge pressure must exceed 200 psi.

e. Minimum flow adjustment of the fuel pump and governor assembly should be accomplished in the following manner:

1. Position valves on test bench as shown below:
   V-1 - closed
   V-2 - open
   V-3 - open
   V-4 - open
   V-5 - open
   V-6 - adjust to maintain fuel pressure between 0 psi and 3 psi.
2. Run unit at 3000 rpm with governor speed control lever against low speed stop.
3. Adjust minimum flow needle valve until governor discharge flow rate is 45 to 55 pounds per hour as measured on rotometer R-1.

f. Droop check the fuel pump and governor assembly in the following manner:

1. Position valves as described in step d, above.
2. Run fuel pump and governor assembly at 3100 rpm with speed control lever adjusted to give fuel flow rate of 240 pounds per hour as measured on rotometer R-1.
3. Gradually increase governor speed until fuel

flow rate is 190 pounds per hour. This point must be reached at governor speed between 3120 rpm and 3130 rpm.

4. Gradually decrease governor speed until fuel flow rate again reached 240 pounds per hour. The drive speed at 240 pounds per hour must not be less than 3085 rpm when approached in decreasing speed direction.

g. Adjust control lever stops on fuel pump and governor assembly in the following manner:

1. Run unit at 3115 to 3125 rpm with speed control lever against high speed stop and adjusted to give fuel flow rate of 260 pounds per hour as measured on rotometer R-1.

2. Set governor speed at 1250 rpm and adjust low speed stop to fuel flow rate of 55 to 65 pounds per hour.

h. Adjust differential relief valve of the fuel pump and governor assembly in the following manner:

1. Adjust valves on test bench as shown below:
   V-1 - closed
   V-2 - open
   V-3 - open
   V-4 - open
   V-5 - open
   V-6 - adjusted to maintain fuel supply pressure between 3 and 5 psi.

2. Driving governor at 3100 rpm, set control lever on high speed stop. Read difference between governor discharge pressure and pump discharge pressure as shown on gages G-1 and G-2 respectively. The differential pressure shall be a minimum of 40 psi. Any differential pressure between 40 psi and 150 psi is satisfactory.

i. Check the ultimate relief valve of the fuel pump and governor assembly in the following manner:

1. Adjust valves on test bench as shown below:
   V-1 - open
   V-2 - closed
   V-5 - open
   V-6 - adjusted to maintain fuel supply pressure between 0 psi and 3 psi.

2. Run test unit between 2950 and 3050 rpm with speed control lever set against high speed stop.

3. Gradually close valve V-1 until fuel flow stops. Governor discharge pressure as measured on gage G-1 must be between 600 and 650 psi. Governors not meeting this discharge pressure should have shims (of .010 inch thickness) added or removed from underneath ultimate valve spring until this requirement is met.

CAUTION

Do not run for more than 10 seconds with the flow through valve V-1 stopped.

7-29. TACHOMETER GENERATOR.

7-30. SPECIAL TOOLS AND EQUIPMENT. No special tools are required for assembly of the tachometer generator. For testing the tachometer generator, the following special equipment is required:

a. A suitable phase indicator
b. Three 40 ohm and three 20 ohm resistors
c. A suitable ohmmeter.
d. A means of driving the generator at 4200 rpm
e. A tachometer indicator capable of reading generator rpm between 1000 and 4200 rpm
f. A root-mean-square reading instrument, [illegible] draws no appreciable current and is free of frequency error, for measuring voltage.

7-31. ASSEMBLY. (See figure 4-21.) The tachometer generator should be assembled in the following manner:

a. Assemble a new oil seal (20) in the outer recess of front end bell so that the wiping edge of the seal is facing the drive end of the rotor shaft.

b. Insert shaft (18) into rotor (19) and secure with pin (17).

c. Assemble outer races of ball bearings in bearing recesses of end bells with thin walls of each bearing facing toward rotor so that ball case of each bearing can be inserted. Add washer (15) and shim (14) to rotor shaft.

NOTE

Ball bearing should be replaced as complete set only.

d. Assemble two bearing retainers (13) to rotor shaft so that curved surface is facing bearing. Before pressing inner race of ball bearing on rotor shaft, be sure that steel pin (17) is centrally located and does not project past shaft surface. Lubricate ball bearings with general purpose grease MIL-L-7711 or equivalent, filling 1/3 of cavity.

e. Place stator (16) in rear end bell so that l[illegible] are projected through receptacle port in top of cas[illegible]. Position terminal receptacle (7) and gasket (8) so that receptacle key is toward drive end of generator. Place insulating sleeving (sealing type, one-half inch long) over the lead wires and resolder stator leads to terminal pins. Position sleeving over connection.

NOTE

The short stator lead is the "C" lead (blue wire) and connects to the lead clamp, thereby grounding the lead to the generator frame. When facing the nameplate end of the generator, the two longer leads (yellow and red) are the "B" and "A" leads respectively, and connect to the corresponding terminal pins. Before reinstalling the lead clamps, make an insulation breakdown test. Apply potential between each of the receptacle pins and generator frame including the shell of the receptacle.

Secure lead clamp (5) with two screws (6). Secure receptacle and gasket to casting with four screws (9).

f. Drop rotor assembly through front end bell, so that inner race and ball cage of bearing fits into outer race which is mounted in end bell. Place rear end bell (10) over rotor assembly, and against front end bell (11). Secure temporarily with four screws [illegible]

g. Test per paragraph 7-32.

h. After completing performance tests, replace gasket (3), nameplate (2) and four screws (4). Align end bells and tighten four screws applying 12 to 15 inch-pounds of torque.

i. Safety wire terminal receptacle screws and name-plate cover screws per specification MIL-W-6713 and Military Standard 35540.

j. Install slinger (1) to shaft on forward face of generator.

7-32. TESTING. The tachometer generator should be tested in the following manner:

a. Check the phase rotation of the tachometer generator by connecting the unit to a suitable phase indicator and check the phase rotation. The sequence of phase should be B-A-C when the unit is driven in a counterclockwise direction as viewed from the shaft end.

b. With the tachometer generator connected to a tachometer indicator or an equivalent load of three 40-ohm resistors connected in a Y, the voltage at 4200 rpm should be 21 volts ± 0.5 volts. The tolerance within the three phases should not, at 4200, exceed ± 0.5 volts.

c. Connect the tachometer generator to three 20-ohm resistors and operate the unit at 1000 rpm. The output voltage should be a minimum of 3.5 volts.

NOTE

The resistance in each phase should be between 20 and 30 ohms and each phase should be within ± 1.0 ohms of each other.

d. Check that the drive key has freedom of movement in castle direction of at least 0.016 in from the center position.

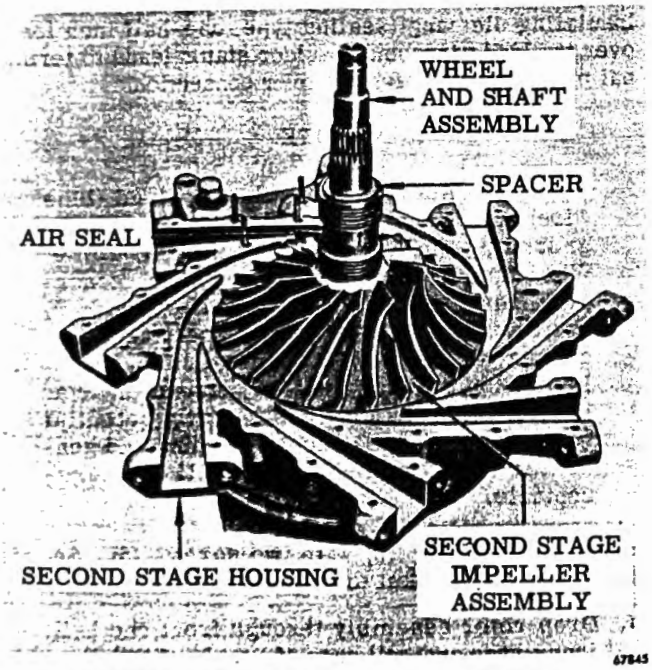


FIGURE 7-13. SECOND-STAGE IMPELLER

7-33. LUBE AND SCAVENGE PUMP.

7-34. SPECIAL TOOLS AND EQUIPMENT. No special tools are required. For testing the lube and scavenge pump, the following special equipment is required:

a. Supply of lubricating oil per specification MIL-O-2104 (grade SAE 10).

b. Varidrive or power source capable of driving pump at 3350 rpm.

c. Container for catching and measuring discharge of oil.

d. Bulb type thermometer calibrated to 38°C (100°F).

e. Necessary tube or hose assemblies and fittings.

f. Oil pressure gage calibrated to 100 psi.

7-35. ASSEMBLY. (See figure 4-18.) The lube and scavenge pump should be assembled in the following manner:

a. Insert relief valve (31) and spring (30) into port at top left rear of body (32). Install adjusting screw (29) and gasket (28) on valve cap (26). Insert spring guide (27) into spring, and install valve cap and attached parts in body on top of spring guide.

b. Insert rear bearing (25) into body, with raised boss down. Insert liner (24) into body with retaining slot forward to receive set screw.

c. Install four blades (22) in rotor (23) so that they are positioned as shown in figure 4-18. To keep blades from falling out of rotor while handling, apply a light coating of petroleum jelly (specification VV-P-236) before installing in rotor. Insert rotor and blades into lower liner with female splined end of rotor up.

d. Insert center bearing (21) into body on top of lower rotor group. Place retaining ring (20) in groove on center drive coupling (19) and place coupling into female spline of lower rotor.

e. Install upper liner (18), rotor (15) and blades (14) in body in the same manner that the lower group was installed.

f. Secure liners against rotation by inserting two set screws (16) through two Lock-O-Seal sets (17) and through body into slots in liner.

g. Place front bearing (13) on top of rotor with its raised boss up. Place spring seat (12) and spring (11) on top of rotor projecting through bearing.

h. Pass drive coupling (10) down through hole in lock nut (2). Place O-ring (9), disc (8) and plate (7) over lower end of shaft. Insert O-ring (6) into bottom of plate, and install drive coupling (5) on keys of plate. Stand this group on the top end of the drive coupling shaft and compress all of the items installed thus far until the retaining ring groove in shaft is visible. Install retaining ring (4) on shaft. Place large O-ring (3) against shoulder on outside of lock nut.

i. Carefully place lock nut and parts attached to it on top of spring, and slowly thread into body until finger tight. Place ends of two punches into spanner holes in top of lock nut, and hold with one hand. With other hand insert a long, heavy screw driver between punches, and using screwdriver as a lever, tighten lock nut until it is flush with top of body. Secure lock nut against turning by inserting set screw (1) through body against lock nut.

7-36. TESTING. The lube and scavenge pump should be tested in the following manner:

a. Preheat oil supply to temperature of 21.1°C (70°F) to 26.7°C (80°F).

b. Drive pump in counterclockwise direction (as viewed from drive end of pump) at 3500 rpm. The scavenge section of the pump should discharge a minimum of 3.2 gallons per minute at an outlet pressure

of 30 to 50 psi.

c. Adjust the pressure relief valve to obtain an output pressure of 65 to 75 psi by turning the adjusting screw. Counterclockwise rotation of the adjusting screw decreases pressure output of the lube section of the pump.

7-37. OIL PRESSURE SWITCH

7-38. SPECIAL TOOLS AND EQUIPMENT. No special tools are required for assembly of the oil pressure switch. For testing the oil pressure switch the following special equipment is required:

a. A gage tester (master gage) for reading oil pressures to approximately 30 psi.

b. An ohmmeter.

c. Supply of lubricating oil, specification MIL-O-2104 (grade SAE 10).

d. Hydraulic valve for controlling oil pressure up to 30 psi.

e. Means of producing 30 psi oil pressure.

7-39. ASSEMBLY. (See figure 4-19.) The oil pressure switch should be assembled in the following manner:

a. Insert actuator (23) in top plate (24). Place two diaphragms (22) on base (21), and place base plate against top plate, and flat plate of actuator. Line up holes in base, diaphragms, and top plate and bolt together with six bolts (20). Insert pressure peg (19) into hole near center of top plate.

b. Secure microswitch (18) to top plate with two washers (17) and two screws (16). Secure microswitch leads (15) with three square shouldered bolts (14) bypassing the bolts through leads, through three insulators (13), and on through three holes in top of body (1). Place three insulator washers (11), washer (10), nut (9), washer (8) and nut (7) on these bolts.

c. Attach mounting bracket (6) to body with two screws (5) which pass through body into top plate (24). Before tightening screws make certain that holes in edge of top plate are lined up with holes in body.

d. Insert spring seat (4) through hole in boss on body and set on top of shouldered actuator shaft. Set spring (3) on spring seat and pass adjustment sleeve (2) over spring and thread sleeve into boss. Install nut (1) onto adjustment sleeve.

7-40. TESTING. The oil pressure switch should be tested in the following manner:

a. Heat supply of oil, specification MIL-O-2104 (grade SAE 10) to a temperature of 16°C (60°F) to 27°C (80°F).

b. Connect an ohmmeter across the unmarked terminal and the "O" terminal on the switch housing.

c. Attach a flexible hose or tubing to the inlet port of the gage.

d. Apply 19 psi oil pressure.

e. Loosen the large adjusting nut protruding from the switch housing and position the adjusting screw to close the electrical circuit at 19 ± 1 psi.

f. Increase the oil pressure to 30 psi and then decrease the pressure to 10 psi and note the oil pressure at which the electrical circuit closes. Switch closure should be checked only when decreasing oil pressure.

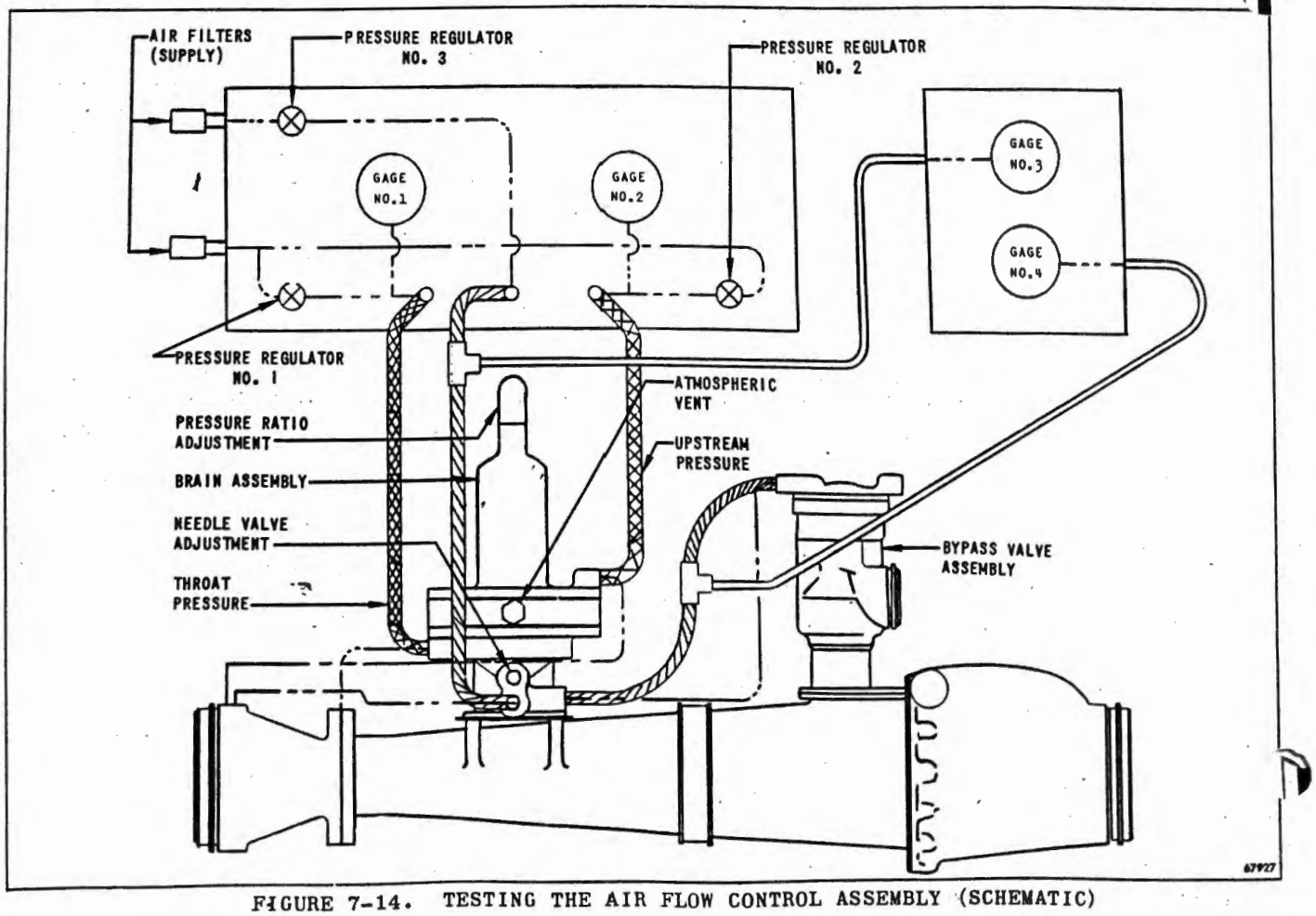


FIGURE 7-14. TESTING THE AIR FLOW CONTROL ASSEMBLY (SCHEMATIC)

NOTE

Turning the adjusting screw inward will cause the switch to close the electrical circuit at a higher pressure.

g. Position the adjusting screw to open the switch at 19 ± 1 psi.

7-41. LUBE FILTER.

7-42. ASSEMBLY. (See figure 4-24.) The lube filter should be assembled in the following manner:

a. Insert new element assembly (9) into case assembly (10) around retaining bar.

b. Position new gasket (8) in top of cover and screw cover assembly (7) on case.

c. Install new drain plug gasket (6) on drain plug (5) and screw drain plug into bottom of case.

d. Install bracket (4) on case and secure in position so that center of bracket lies 50° clockwise from centerline of filter inlet port. Secure bracket in position with two lock washers (3) (next to boltheads), two bolts (2) and two nuts (1).

7-43. ACCELERATION LIMITER.

7-44. SPECIAL TOOLS AND EQUIPMENT. No special tools are required for assembly of the acceleration limiter. For testing, the following special equipment is required (see figure 7-19):

a. Room with ambient temperature controlled between 18.3°C (65°F) and 26.7°C (80°F).

b. Air supply of at least 30 psig with pressure regulating air valves.

c. A high pressure pump (John S. Barnes Corp., Rockford, Illinois - part number 400491) coupled to a varidrive.

d. Supply of fuel (specification MIL-F-5624A(JP-4).

e. Two 9.5 gallons per hour (each) fuel nozzles with filters, and a suitable container to catch spray from nozzles.

f. Pressure gage of 0 - 50 psi.

g. Pressure gage of 0 - 600 psi.

h. Tachometer indicator graduated to 4000 rpm.

i. Relief valve of 10 - 40 psi.

j. Relief valve of 600 psi.

k. Necessary tube or hose assemblies and fittings.

7-45. ASSEMBLY. (See figure 4-15.) The acceleration limiter should be assembled in the following manner:

Screw nut (21) on bushing (18) and place three O-rings (20) on bushing. Screw bushing into bottom of body (19) and lock bushing with nut. Insert plunger (17) into top of bushing and insert pin (16) into plunger. Place spring (15) over pin and plunger on top of bushing. Set clamp bolt (14) on top of pin and spring. Place diaphragm (13) and washer (12) on top of clamp bolt, and insert pin (11) so that one end is flush with side of clamp bolt. Place lock washer (10) on top of washer and pin and place tab of lock washer (9) into slot of lock washer. Screw nut (8) on clamp bolt and set loading spring (7) on exposed shoulder of clamp bolt. Place O-ring (6) on adjusting screw and turn adjusting screw (5) into cover from the bottom. Place cover (4) on top of body, being careful not to displace loading spring alignment with adjusting screw, and secure cover to body with four washers (3) and four bolts (2). Install and tighten nut (1) on adjusting screw.

7-46. TESTING. The acceleration limiter should be tested in the following manner:

a. All tests to be conducted in room having ambient temperature controlled between 18.3°C (65°F) and 35°C (95°F).

b. Set up test stand as shown in figure 7-18.

c. Testing fluid to be premium diesel, specification MIL-F-896.

d. Connect port "E" of acceleration limiter to air supply of at least 30 psi.

e. Connect port "D" of acceleration limiter to sump.

f. Connect port "B" of acceleration limiter to pressure side of fuel pump.

g. Connect port "C" of acceleration limiter to inlet side of fuel pump.

h. Adjust upper adjusting screw on acceleration limiter, counterclockwise from above, to extreme position and turn lower adjusting screw, counterclockwise from below, four turns from flush with lock nut.

i. Check acceleration limiter for minimum acceleration setting at pump speeds and air pressures listed in Table XI. For air pressures and pump speeds listed, fuel nozzle line pressure as indicated on gage No. 2 must be equal to or less than values listed in Table XI.

TABLE XI
MINIMUM ACCELERATION PRESSURES

PUMP RPM	AIR PRESSURE PSIG	NOZZLE LINE PRESSURE PSIG
1500	5	50
2300	15	150
2800	25	260

j. Loosen lock nut on upper adjustment screw of acceleration limiter and turn screw flush with lock nut.

k. Loosen lock nut on lower adjustment screw and turn screw in to extreme position.

l. Check acceleration limiter for maximum acceleration setting at pump speeds and air pressures listed in Table XII. For air pressures and pump speeds listed, fuel nozzle line pressure, as indicated on gage No. 2, must be equal to or greater than fuel nozzle line pressure values listed in Table XII.

NOTE

If the nozzle pressure increases more than 15 psi when the pump speed is increased from 2300 rpm to 2700 rpm, while maintaining air pressure at 15 psi, the limiter is not operating properly and a check for interference in the moving valve parts should be made.

TABLE XII
MAXIMUM ACCELERATION PRESSURES

PUMP RPM	AIR PRESSURE PSIG	NOZZLE LINE PRESSURE PSIG
1500	5	90
2300	15	240
2700	15	Not more than 15 psi over that at 2300 rpm
2800	25	390

m. To test for allowable acceleration limiter leakage, measure leakage from port "D." Leakage must not exceed 100 cubic centimeters per minute at fuel nozzle line pressure of 360 psig and air pressure of 30 psig.

NOTE

If acceleration limiter cannot be adjusted within the aforementioned limits, the unit should be replaced.

n. With pump speed of 2800 rpm and air pressure of 25 psig at port "E," back off on lower adjusting screw until reading of 350 to 355 psi is reached on gage No. 2. Lockwire lock nuts of lower and upper adjusting screws in these positions in accordance with MIL-W-6713 and Military Standard 35541.

7-47. FUEL SOLENOID.

7-48. SPECIAL TOOLS AND EQUIPMENT. No special tools are required for assembly of the fuel solenoid. For testing the fuel solenoid, the following special equipment is required:

a. Voltmeter capable of registering 24 volts.
b. Ammeter capable of registering five amps.
c. Source of pressurized fuel (specification MIL-F-5624A, JP-4), with maximum pressure of 300 psi.
d. Necessary hose or tube assemblies and fittings.

7-49. ASSEMBLY. (See figure 4-17.) The fuel solenoid should be assembled in the following manner:

a. Insert plunger guide (4) in plunger (3) and insert plunger, pointed end first, into electro-magnet. Screw electro-magnet (2) firmly into valve body.

7-50. TESTING. The fuel solenoid should be tested in the following manner:

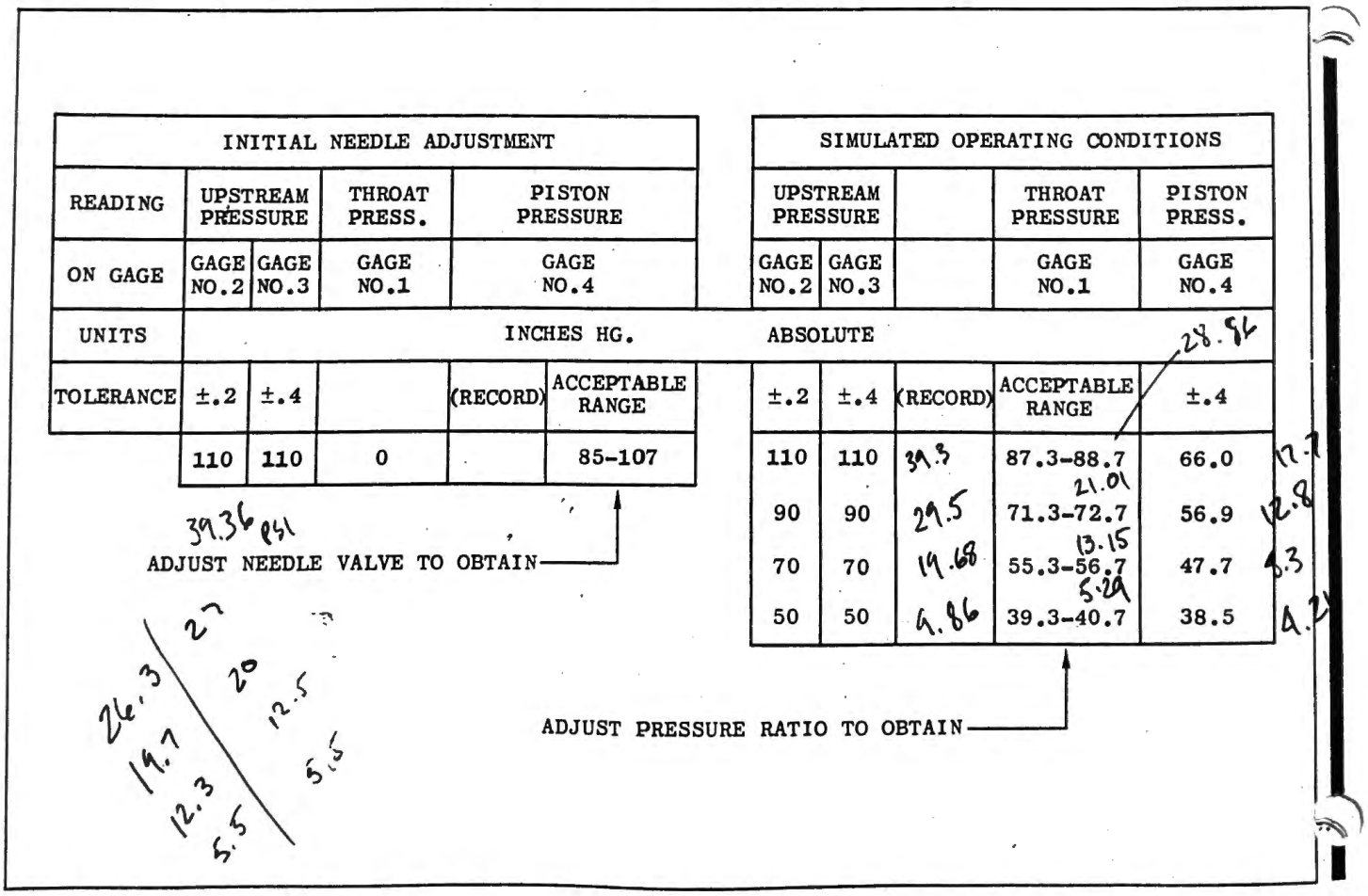


FIGURE 7-15. AIR FLOW CONTROL ASSEMBLY TEST CHART

Using 24 volt power source energize fuel solenoid open valve and listen for a click as solenoid is energized. Valve must remain open until circuit is de-energized.

Test valve for internal leakage through valve by pressurizing inlet port to static pressure of 300 psi. Any evidence of leakage requires that valve be rejected.

51. LOW PRESSURE FUEL FILTER.

52. ASSEMBLY. (See figure 4-23.) The low pressure fuel filter should be assembled in the following manner:

a. Insert spring guides (22) in relief valve springs (21) and insert springs in relief valve pistons (20). Place closed end of pistons in valve seats. Insert relief valves, spring guide first, into valve cavities in head (23). Secure with relief valve seats (19).

b. Place V-ring adapter (18) with flat side down inside plug boss on top of head. Place two new packings (17) together with convex side up and position on top of V-ring adapter. Screw plug (16) into boss in head.

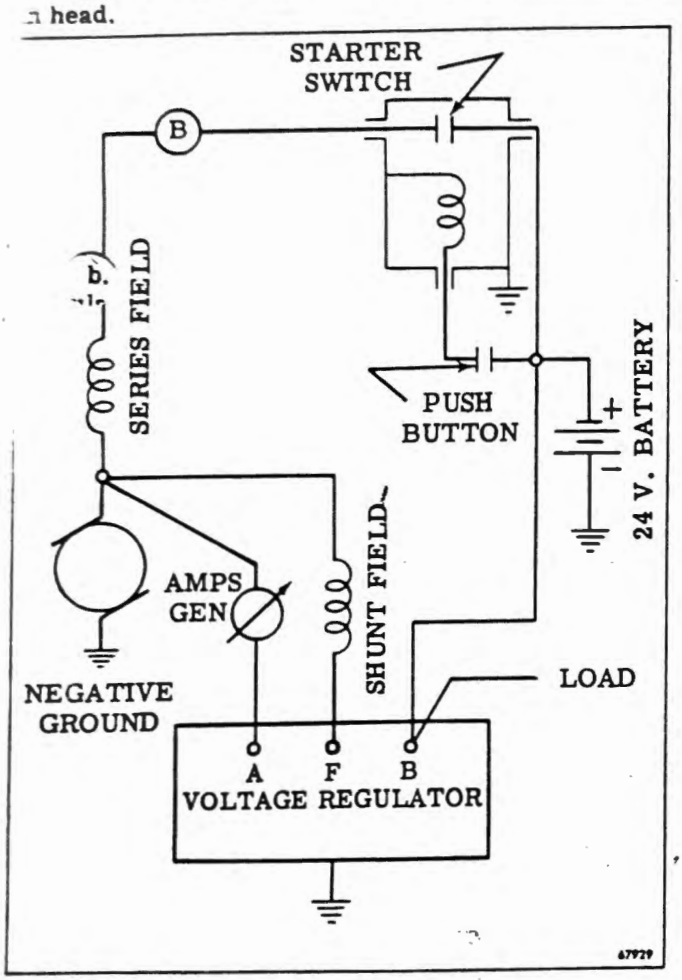


FIGURE 7-16. STARTER-GENERATOR TEST WIRING DIAGRAM

Install drive shaft retainer (15) in grooved seat on drive shaft and slip retainer cap (14) over end of drive shaft to cover retainer. Insert drive shaft of element assembly (13) in head and push shaft carefully through V-ring retainer, packings and plug until drive shaft retainer is against head casting.

d. Screw nut (12) and handle assembly (11) on drive shaft and secure handle assembly with nut.

e. Insert knife and frame assembly in head and secure with two washers (10) and two screws (9).

f. Slip new case gasket (7) in seat inside head.

g. Screw case (4) into head.

h. Install new drain plug gasket (6) over drain plug (5) and screw drain plug in case.

i. Slip bracket (1) on case and position so that mounting face is parallel to centerline of the inlet and outlet ports. Secure bracket with screw (3) and nut (2).

7-53. HIGH PRESSURE FUEL FILTER.

7-54. ASSEMBLY. (See figure 4-16.) The high pressure fuel filter should be assembled in the following manner:

a. Insert pistons (9), closed end first, into relief valve housings in head. Insert springs (8) in pistons and place spring guides (7), shaft end first, inside projecting ends of springs. Install plug gaskets (6) on plugs and screw into head.

b. Install case gasket (4) beneath retaining ring inside case. Insert element assembly (3), closed end first, into case. Screw head (2) into case (1). Lockwire two valve plugs together and head and case together. Lockwire in accordance with specification MIL-W-6713 of .032 inches diameter should be installed in accordance with Military Standard 33540.

7-55. IGNITER COIL ASSEMBLY.

7-56. SPECIAL TOOLS AND EQUIPMENT. No special tools are required for assembly of the igniter coil assembly. For testing of the igniter coil assembly the following special equipment is required:

a. An ammeter capable of registering three amperes.

b. 24 volt dc power supply.

7-57. ASSEMBLY. (See figure 4-22.) The igniter coils should be assembled in the following manner:

a. Insert plug (29) in top center of case.

b. Using plate (28), two washers (27), and two screws (26) secure vibrator assembly (24) to coil assembly (25).

c. Place two spacers (23) on long posts at top of coil. Set condenser and bracket assembly (20) on top of the spacers, and secure with two washers (22) and two nuts (21). Screw contact (19) into hole in center of bracket on condenser.

d. Place insulating cup (18) on coil.

e. Place nut (17), washer (16), and washer (15) on post on top of condenser bracket. Install coil in case so that post goes into slotted hole in top of case. Install adapter plate (14) over post protruding from case, so that it rests in slotted hole. Secure with washer (13), washer (12) and nut (11).

f. Insert end of the glow coil lead through knurled nut (8), washer (9), and gland (10). Pull lead through hole in boss on top of case so that gland seats inside boss and washer rests on top of boss. Screw knurled nut onto boss to secure lead. Place washer (7) on short post on top of coil. Place glow coil lead terminal on post and secure with washer (7) and nut (6).

g. Place cover (1) against case (2) and secure with four washers (4) and screws (3).

7-58. TESTING. The igniter coil assembly should be tested in the following manner (see figure 4-22):

a. Remove cover (1) from igniter coil assembly by removing four washers (4), four washers (5) and 4 screws (3).

b. Attach case (2) to suitable common ground.

c. Attach 24 volt dc power supply to terminal "A" on coil assembly (25) and to common ground.

d. Attach high tension ignition lead from receptacle "B" to suitable spark gap of .080 to 0.10 inch. Return opposite side of gap to common ground.

e. Attach ammeter to lead wire between power source and common ground.

f. Apply 24 volt dc power and measure current draw through igniter coil assembly. Current draw should be from 1.0 to 1.2 amperes.

7-59. EXHAUST TEMPERATURE PYROMETER.

7-60. SPECIAL TOOLS AND EQUIPMENT. No special tools are required for assembly of the exhaust temperature pyrometer. For testing the pyrometer the following equipment is required.

a. Ohmmeter.
b. Potentiometer.
c. Wheatstone bridge.
d. Battery runup box.

7-61. ASSEMBLY. (See figure 4-26.) The exhaust temperature pyrometer should be assembled in the following manner:

a. Install three washers (26) and three terminal nuts (25) on terminals at rear of chassis (24). If thermister (23) and two resistors (22) were removed, resolder them to their respective leads. Check all soldered connections on chassis terminals and on thermister and resistors for security.

b. Place magnet assembly (21) between two rubber bracket straps (20). Place brass bracket strap (19) in front of this group. Line up holes and secure to chassis with three special studs (18).

c. Secure moving element assembly (15) to magnet with two nuts (16) and two dial studs (17). Resolder leads to moving element assembly with a small soldering iron, being careful not to damage moving element assembly.

d. With two washers (14) and two dial screws (13) secure dial plate (12) to dial studs on face of moving element assembly behind needles.

e. Place cushioning O-ring (11) on back of chassis, and insert instrument mechanism in case (10). Secure mechanism in case with sealing nut (9). Place gasket (8) on flange of case.

f. Secure finger (6) and arm (5) to window (7) with two washers (4) and two screw pins (3). Place window assembly on top of gasket and lay window retainer (2) on top of window. Screw case cap (1) on case to secure window.

7-62. TESTING. The exhaust temperature pyrometer should be checked in the following manner:

a. Connect battery runup box to exhaust temperature pyrometer with chromel and alumel leads and calibrate leads to 8 ± 0.10 ohms with a Wheatstone bridge.

b. Connect a potentiometer to measure millivoltage across terminals of runup box. Potentiometer should have not more than .02 millivolt scale error.

c. Using table XIII as a reference, determine millivoltage output value equivalent to 1200°F and compensate for ambient temperature by subtracting millivoltage listed for ambient temperature.

TABLE XIII
MILLIVOLTAGE EQUIVALENT

AMBIENT TEMPERATURE	MILLIVOLT OUTPUT
50°F	.40
55°F	.51
60°F	.62
65°F	.73
70°F	.84
75°F	.95
80°F	1.06
85°F	1.17
90°F	1.29
95°F	1.40
100°F	1.52

d. Check position of temperature indicating needle, and if necessary, zero by turning lower adjusting screw to indicate 1200° ± 5°F.

NOTE

If exhaust temperature pyrometer cannot be adjusted to 1200° ± 5°F, pyrometer should be rejected.

e. Check pyrometer for permissible scale error at test points listed in table XIV.

TABLE XIV
PYROMETER TEST

TEST POINT	MILLIVOLTS	PERMISSIBLE ERROR
850°F	18.70	±37.5°F
1000°F	22.25	±37.5°F
1100°F	24.62	±25.0°F
1200°F	26.98	± 5.0°F

f. Adjust stationary needle by turning upper adjusting screw on face of gage to 1210°F.

g. Attach one lead of ohmmeter to "CONT." terminal on back of case and attach other lead of ohmmeter to case.

h. Apply millivoltage to slowly move temperature indicating needle up scale until over-temperature cut-out circuit closes as indicated by ohmmeter. Circuit should close when applied millivoltage is equivalent to 1210° ± 5°F as derived from table XIII.

NOTE

If temperature indicating needle bounces when it contacts stationary needle, the polarity of the pyrometer is reversed. Correct polarity by reversing leads "B" and "C". (See figure 4-26.)

i. Disconnect runup box, potentiometer leads and ohmmeter from pyrometer.

j. Seal upper and lower adjusting screw on face of pyrometer.

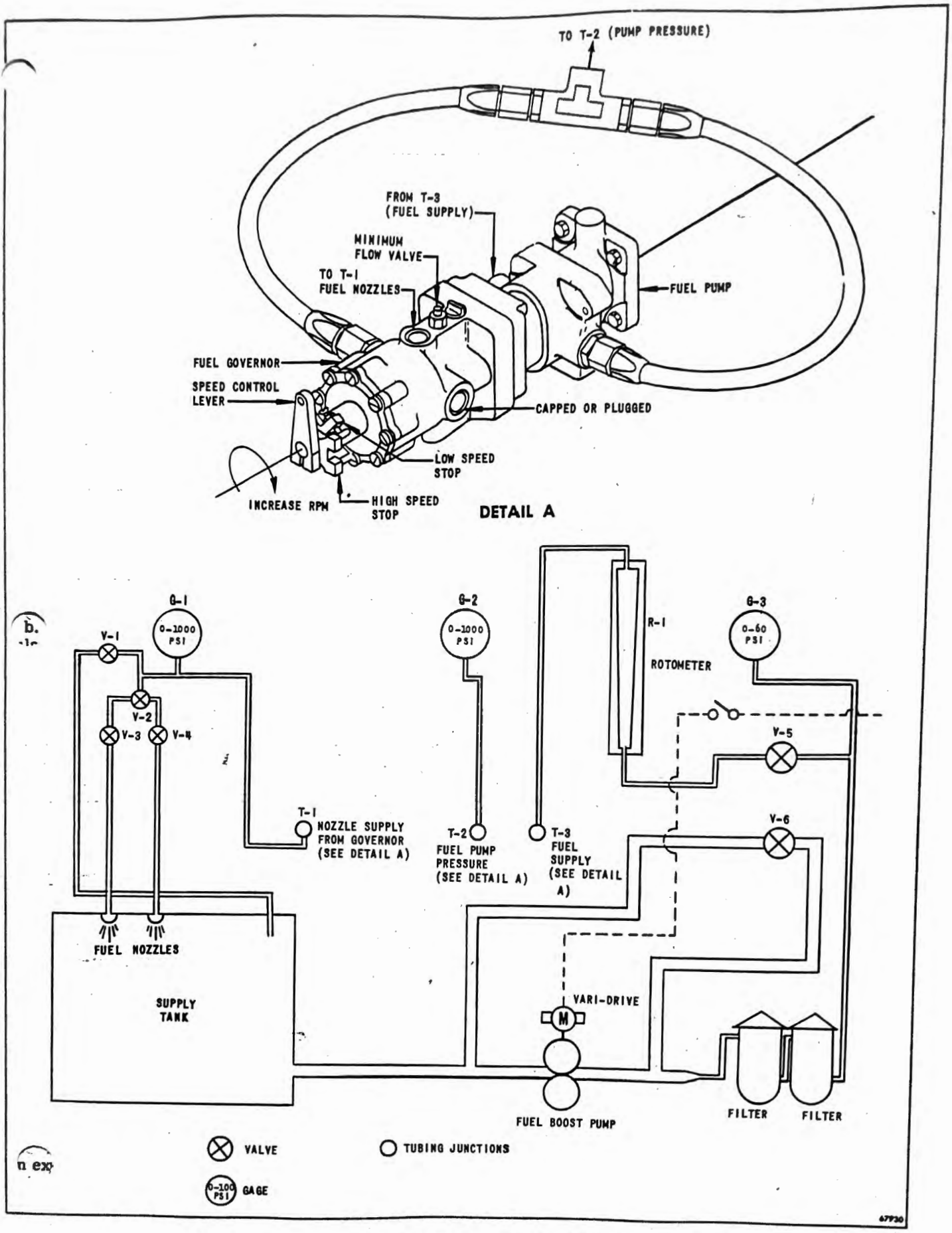


FIGURE 7-17. TESTING THE FUEL PUMP AND GOVERNOR ASSEMBLY

7-63. INLET SILENCER ASSEMBLY.

7-64. ASSEMBLY. (See figure 4-25.) The inlet silencer should be assembled in the following manner:

a. Secure inner shell assembly (18) to inner dome assembly (17) with 12 bolts (16), 12 spacers (15), 48 washers (14) and 12 nuts (13).

b. Install insulation pad (12) on inner dome assembly and position dome outer shell (11) to align with inner cone assembly. Secure with washer (10) and bolt (9).

c. Position insulation pads (8) on inner shell assembly and install outer shell assembly (7). Secure sections of silencer assembly using 12 bolts (6), 48 washers (4), 12 spacers (5) and 12 nuts (3).

d. Secure adapter flange (1) to outer shell using 8 screws (2).

7-65. VOLTAGE REGULATOR.

7-66. SPECIAL TOOLS AND EQUIPMENT. No special tools are required for installation of the voltage regulator. For testing the voltage regulator the following equipment is required:

a. 24 volt dc battery (fully charged).
b. 24 volt generator.
c. Means of driving generator at 3000 rpm.
d. Ammeter.
e. Voltmeter.
f. Headphone of 2000 ohms or higher.

7-67. TESTING. The voltage regulator should be tested in the following manner:

a. Disconnect lead from terminal "B" and install ammeter between "B" terminal and lead removed from terminal. Connect voltmeter between regulator "A" terminal and regulator base, and place thermometer near regulator (about 2 inches away).

b. Disconnect field lead from regulator "F" terminal and insert variable resistance (3 amp - 50 ohm capacity) between lead and regulator terminal.

c. Run generator at about 1000 generator rpm. Insert all resistance in field circuit, then slowly reduce resistance, noting voltage reading just before change, caused by closing of cutout relay. Increase charging rate to 25 - 27 amperes, then reduce charging rate by inserting resistance in field circuit. Note voltmeter and ammeter readings just before cutout relay opens and ammeter reading drops to zero. Closing voltage should be 26 - 27 volts, and opening current should be 3 - 5 amperes.

d. An accurate method for noting exact instant of opening or closing of cutout relay is to connect a headphone (2000 ohms, or higher) to the battery and armature terminals of the regulator. When contact opens or closes, a click will be heard in headphone.

e. To adjust closing voltage, change armature spring tension by turning adjusting nut at lower end of spring hanger. Increase spring tension to lower voltage. To adjust opening voltage, raise or lower stationary contact keeping contactor aligned. Increasing contact gap lowers opening voltage. Change contact gap by expanding or contracting the stationary contact bracket, keeping contact aligned. Do not adjust gap between contacts to less than .025 inches.

f. Connect ammeter as noted above, or leave connected, and connect voltmeter between the regulator "B" terminal and the regulator base. Remove variable resistance from the field circuit.

g. Run generator at one half maximum output for 15 minutes to be certain regulator is at normal operating temperature.

h. Stop generator then bring it up to 2500 rpm. Adjust amperage to one half maximum output by loading circuit and note voltmeter reading. Reading should be within limits specified in table VI. To adjust operating voltage change armature spring tension by bending hanger at lower end of armature spring or by turning the adjusting nut. After each adjustment, stop generator then restart. Bring it up to speed and adjust current before taking reading.

i. To obtain an accurate indication of operation of voltage regulator unit connect a headphone (2000 ohms or higher) between the "F" terminal and ground to pick up the sound of opening and closing of contacts. Clicks should be regular and clear without missing. If tone is not clear and regular, remove regulator cover and inspect contacts. Contacts should be flat and not burned and should be aligned to make full face contact. If contacts need cleaning or repairing refer to Section VI.

j. Connect regulator and instruments as described above in paragraph f, and run generator at approximately 300 rpm. Load circuit so that generator must charge at its maximum rate. Ammeter should show a reading of 25 - 27 amperes. To adjust operating amperage, change armature spring tension by turning nut at lower end of armature spring. After each adjustment stop generator, and restart. Bring generator up to speed and take ammeter reading.

k. In order to obtain accurate indication of operation of current regulator unit, connect a headphone (2000 ohms or higher) between regulator "F" terminal and ground to pick up sound of opening and closing of contacts. Clicks should be clear and regular without missing. If tone is not clear and regular, inspect the contacts. Contacts should be flat and not burned and should be aligned to make full face contact. If the contacts need cleaning or repairing refer to Section VI.

l. Inspect contacts on all three coil units. In normal use contacts will become grayed. If contacts are burned or dirty or if they are not smooth, refer to Section VI for cleaning and repair instructions.

m. Operate generator at one half maximum output for five minutes. Repeat testing procedure for all coil units as described in steps a through k.

TABLE XV
VOLTAGE LIMITS

AMBIENT TEMPERATURE °F	OPERATING VOLTAGE ± .40
50	29.38
60	29.34
70	29.30
80	29.26
90	29.22
100	29.18
110	29.14
120	29.10

7-68. VAPOR SPARK PLUG ASSEMBLY.

7-69. SPECIAL TOOLS AND EQUIPMENT. No special tools are required for testing the vapor spark plug

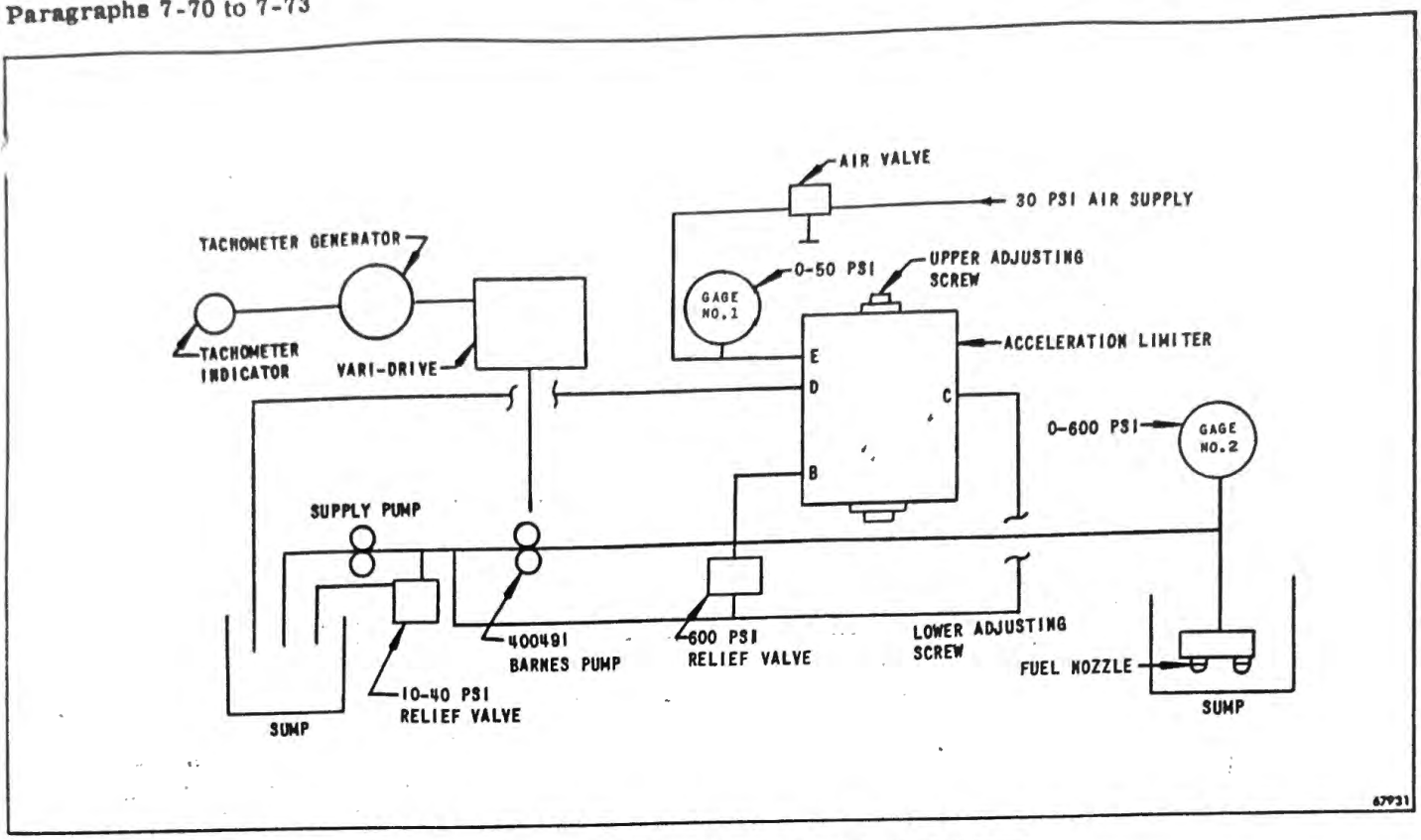


FIGURE 7-18. TESTING THE ACCELERATION LIMITER

assembly. For testing of the vapor spark plug assembly the following equipment is required:

a. 60 psi air supply.
b. Air gage capable of registering up to 60 psi.
c. Manual air valve.
d. 24 volt dc power source.
e. Ammeter.
f. Igniter coil assembly.

7-70. TESTING. The vapor spark plug assembly should be tested in the following manner:

a. Slip O-ring around electrode end of plug and insert plug in small cylinder which will accept plug in close fit. Clamp or bolt plug to cylinder.

b. Equip other end of cylinder with suitable fitting to accept pressurized air supply line.

c. Install an air pressure gage and manual valve to supply line and attach air supply line to cylinder.

d. Immerse plug and cylinder in water and admit air at 60 psi to cylinder. Check for bubbles from spark plug case indicating leakage. No leaks should appear.

e. Connect one lead of a 22 ± 2.0 volt dc power supply to glow coil terminal on side of plug. Attach other lead of power supply to ground by hooking into one mounting hole on plug flange. Install ammeter in circuit.

f. Apply 22 ± 2.0 volt dc current to circuit for a maximum period of five seconds. The glow coil should draw 12 ± 3.0 amperes, and the glow coil should glow cherry red.

g. Set spark gap of plug points to .080 - .100 inches.

h. Connect high tension lead to top of plug and high tension receptacle of igniter coil assembly. Ground plug shell to coil case by attaching wire between mounting bolt hole in plug flange, and mounting bolt hole in coil flange.

CAUTION

Plug shell must be grounded to coil case to prevent damage to coil.

i. Connect 24 volt dc power supply to terminal "A" (figure 4-22) and ground to coil case.

j. Apply 24 volts dc to this primary circuit and check for spark. With proper gap, spark should only occur at tip of electrode.

7-71. CHECK VALVE.

7-72. SPECIAL TOOLS AND EQUIPMENT. No special tools are required for testing the check valve. For testing the check valve the following equipment is required:

a. Means of supplying fuel at 45 psi.
b. Fuel pressure gage capable of registering up to 50 psi.

7-73. TESTING. The check valve should be tested in the following manner:

a. Attach line, with pressure gage installed, between pressure source of fuel and check valve, and provide receptacle for fuel.

b. Gradually apply pressure and note pressure at which valve opens.

c. If valve opens below 35 psi or above 45 psi valve should be rejected.

SECTION VIII

FINAL ASSEMBLY, TESTING AND INSTALLATION

8-1. GENERAL.

8-2. The instructions in paragraph 7-2 are also applicable to final assembly of the engine and should be observed in the performance of operation described in this section.

8-3. GAS PRODUCER SECTION.

8-4. SPECIAL TOOLS. Refer to Section III, Table II, Group 1 for special tool required for assembly of gas producer section.

8-5. ASSEMBLY. (See figure 4-7.) Assemble the gas producer section in the following manner:

a. Coat both sides of gasket (21) with a thin film of No. 3 Permatex. Assemble rotor section (20) to sump and base section (25) by positioning gasket (21) over two dowel pins. Carefully locate rotor section over two dowel pins and secure, using 11 washers (24), 11 washers (23) and 11 bolts (22).

NOTE

It is recommended for convenience that the rotor section be assembled using the sump and base section as a buildup stand. See paragraph 7-13 for assembly of the rotor section.

b. Install burner section in following manner:

1. Install each burner unit by fitting rear end of burner shell into flange on nozzle box. Install gasket (19) and secure burner elbow assembly to compressor casing by installing seven washers (18), seven washers (17), five bolts (15) and two bolts (16).

NOTE

For the remainder of the keyed index items in step "b," see figure 4-9.

2. Secure burner unit to nozzle box with clamp (13). Torque nut to 60 inch-pounds.

3. Install nipples (11), ball sleeves (12) and crossfire tube (10) between the right and left burner units by tightening large hex nuts at each end of tube.

4. Install igniter leads (9).

5. Secure glow coil lead (5) by installing screw (8), washer (7) and nut (6).

6. Install two tie bolts (4), two washers (3), two special washers (2) and two nuts (1).

NOTE

To facilitate assembly of gas producer section install lube and scavenge pump on rotor section before installing accessory drive assembly.

c. Install lube and scavenge pump in following manner:

NOTE

For the keyed index items in step "c," refer to figure 4-4.

1. Tighten nipples (63), (62) and (61) into pressure outlet, scavenge outlet and pressure inlet ports of lube and scavenge pump. Screw bushing (46) in scavenge inlet port.

2. Install new gasket (68) and lube and scavenge pump (64), with pressure adjusting screw toward left side of engine, on the mounting studs beneath rotor housing using four washers (66) and four nuts (65).

3. Working through hole in top of rotor housing, install lube and scavenge pump drive shaft (67), mating female drive splines over male splines of pump. Position square end of drive shaft so it will engage square recess in helical gear when accessory drive assembly is installed.

NOTE

To facilitate installation, the starter-generator junction box should be installed on the starter-generator prior to installation of the starter-generator on the accessory drive.

4. Remove four screws from terminal base of starter-generator. Install junction box flanges against terminal base and secure in position beneath side cover retainers, using four screws. Lockwire screws together on top and bottom of terminal base per specification MIL-W-6713 and in accordance with Military Standard 33540.

d. (See figure 4-7.) Install starter-generator (6) and gasket (7) on accessory drive assembly with six bolts (8) and washers (9). Install tachometer-generator (10) and gasket (11) on drive pad of accessory drive assembly and secure with four washers (13) and nuts (12).

NOTE

The starter-generator should be assembled to the accessory drive assembly prior to installation of the accessory drive as there is insufficient end clearance to permit later installation. The tachometer-generator is installed at this time for convenience.

e. Install new O-ring (5) in counterbore where rotor housing is machined to receive accessory drive assembly. If necessary, add shims beneath O-ring gasket so that upper surface of O-ring is slightly above machined surface of rotor housing. Install

gasket (4) (coated on both sides with thin film of No. 3 Permatex) so that hole in gasket and O-ring do not coincide. Carefully install accessory drive assembly (1) to position on rotor housing making sure that square end of lube pump drive shaft engages square recess in helical gear inside end cap of accessory drive. Secure accessory drive housing to rotor housing using six washers (3) and six nuts (2).

NOTE

Make certain that drive gear in accessory drive assembly meshes with pinion gear of balancing assembly. Using special tool group one (figure 8-1) tighten nuts to secure accessory drive assembly on rotor housing.

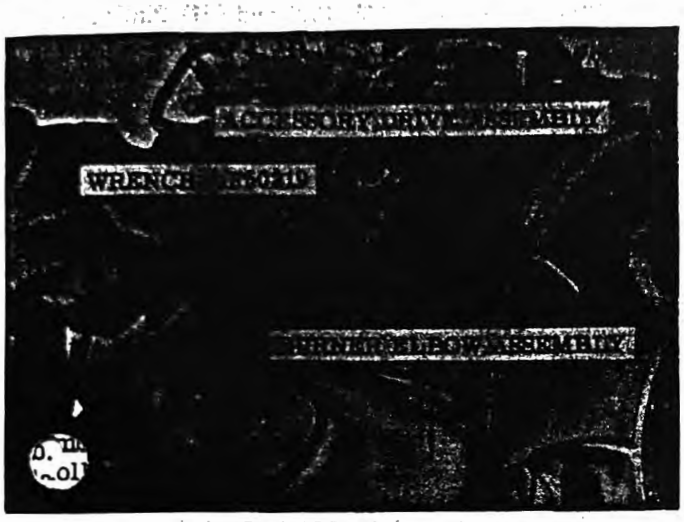


FIGURE 8-1. REMOVING AND INSTALLING ACCESSORY DRIVE ASSEMBLY

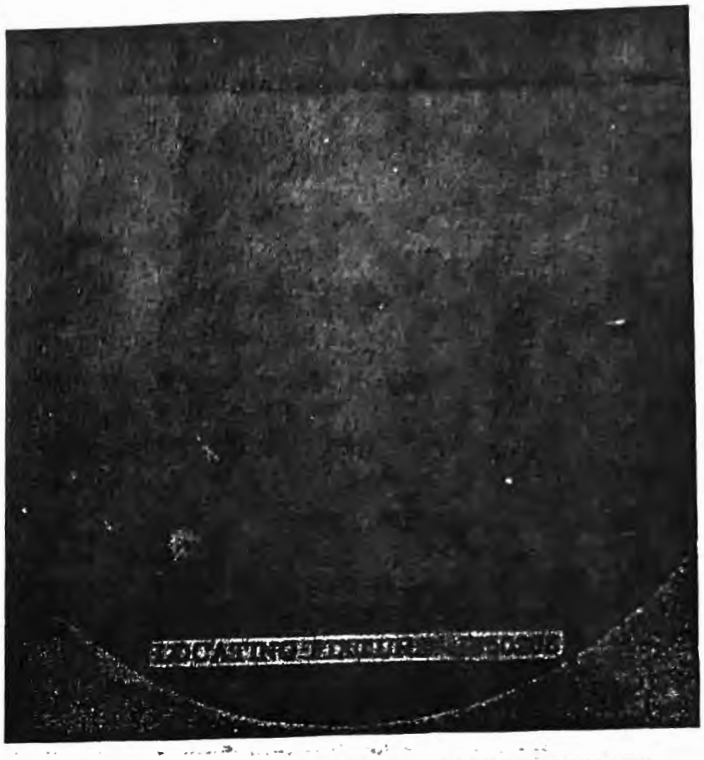


FIGURE 8-2. CHECKING CLEARANCE BETWEEN NOZZLE RING ASSEMBLY AND WHEEL AND SHAFT ASSEMBLY

8-6. ENGINE ASSEMBLY.

8-7. FINAL ASSEMBLY OF ENGINE. (See figure 4-2.) Final assembly of the engine should be accomplished in the following manner:

a. Install three Lord Mount brackets (24) (two on lower sides of two-stage compressor and one in front of sump and base) with flat sides down, to base of engine using twelve washers (26) and twelve bolts (25). Install two spacers (23) in holes in each bracket. If engine mounts have not been installed in engine mount bracket assemblies in power package, install three engine mounts (20) by holding in position in brackets and inserting three bolts (22) through mounts and spacers. Secure three bolts with three nuts (21).

b. (See figure 4-2.) Wrap insulation blankets (18) and (19) in position around nozzle ring and lace securely with lockwire. Stick four pieces of clay at 90° intervals against hub of first-stage wheel at base of blades and hold nozzle ring firmly in position against mating flange of nozzle box. Remove nozzle ring and measure thickness of clay to determine if clearance between turbine wheel and nozzle ring inner shell is less than .025 inch. (See figure 6-5, F.) If tolerance is less than .025 inch, grind face of inner shell slightly to obtain minimum clearance. Attach nozzle ring (16) to mating flange of nozzle box and secure in position with clamp (17).

c. Hang special tool, group 11 (figure 8-2) on rear face of nozzle ring, with three pieces of clay evenly spaced on rear face of tool. Place two-stage compressor assembly on mounting studs in sump and base and push forward into position. Secure with nuts, making sure that compressor is firm against oil sump and base assembly and that turbine wheel is aligned with special tool. Remove compressor and check that thickness of tool and compressed clay is between 0.160 and 0.190 inches. (See figure 6-5, G.) Install shim (15) as required to obtain correct clearance. Remove special tool form nozzle ring. Install two-stage compressor assembly (34) on mounting studs and snug in position againts sump and base using four washers (36) and four lock nuts (35). Insert small wedges on both sides between base of two-stage compressor assembly and build-up stand on which engine is being assembled. Alternately tap wedges and check clearance between tips of blades and nozzle ring. Check that clearance all around is between 0.025 and 0.040 inches. (See figure 6-5, H.) With proper tip clearance obtained, progressively tighten (using 450 inch-pounds of torque) mounting nuts to prevent canting of compressor against mounting surface of sump and base. Remove wedges.

d. Install engine lubrication system in accordance with instructions in paragraph 8-9, noting that installation of clamp supporting end of oil breaker exhaust tube assembly is accomplished after installation of exhaust collector shell assemblies.

e. Install engine fuel system in accordance with instructions in paragraph 8-11.

f. (See figure 4-1.) Install insulation blankets (22)

and (21) on right-hand exhaust collector shell assembly (15) and lace in position with lockwire. Install insulation blankets (19) and (20) on left-hand exhaust collector shell assembly (14) and lace in position with lockwire. Place exhaust collector shell assemblies in position around nozzle ring and secure together using four bolts (18), eight washers (17) and four nuts (16).

g. (See figure 4-2.) Install air flow control assembly (4) to its bracket on sump and base in the following manner:

1. Attach clamp (6) to end of bracket on sump and base, using two bolts (9), two washers (8) and two nuts (7). With clamp open to receive air flow control assembly, lift control assembly into clamp, insert throat end into seal, against mating surface of air collector outlet, and tighten clamp with its fastening nut.

2. Slip one inner seal (5) of connector assemblies onto end of air collector outlet and other inner seal onto end of check valve of air flow control assembly. Place both connectors (3) around both connector seals and secure in position, using two bolts (2) and two nuts (1).

h. (See figure 4-1.) Screw air collector thermocouple into boss in right side of air collector.

i. (See figure 4-1.) Install junction box (9) on front of rear hoist fitting using two screws (12), two washers (11) and two nuts (10).

j. Install four thermocouples (5), green side down, in bosses on exhaust collector shells. Secure thermocouples to mounting flanges of bosses, using two bolts (8), two washers (7) and two nuts (6).

k. To two center and two lower terminal posts on junction box, attach eight thermocouple terminal wires (two wires to a post, green wires on right side and white wires on left side) using eight nuts.

8-8. ENGINE LUBRICATION SYSTEM.

8-9. INSTALLATION. (See figure 4-4.) The engine lubrication system should be installed in the following manner:

a. Attach oil pressure switch (112) to rear of right hand ignition coil bracket using two bolts (115), two washers (114) and two nuts (113).

b. Place new O-ring (111) (see detail D) on cap (109) and attach chain (108) to top of cap and to side of body, using two screws (110). Place new oil breather gasket (107) against hex head of oil breather adapter. Insert oil breather adapter (103) through tube assembly (106) and install new oil breather gasket (105) over end of oil breather adapter. Screw threaded end of adapter into threaded cavity in top of breather body (104). Position breather output port of adapter on breather body to face toward rear of engine. Screw cap into hex end of adapter. Place breather body cover (102) over port in top of breather body and secure in position using clamp (101).

c. Screw nut (100) onto 90° elbow (98). Install new O-ring (99) on same end of elbow and screw elbow into boss in bottom of breather assembly. Position elbow so that open end of elbow points toward left side of engine.

d. Secure breather assembly (94) and new breather body gasket (97) to mounting studs on accessory drive cover using two washers (96) and two nuts (95).

e. Install two clamps (91) on connector sleeve tube (92) and install connector sleeve tube over breather and over breather exhaust tube (93). Install clamp (90) through bracket on breather exhaust tube and around left exhaust stack.

f. Install lube and scavenge pump as described in paragraph 8-5, step "e."

g. Slide screen (85) (detail C) on oil jet (87). Place new O-rings (89) and (88) in their seats on jet and screw oil jet assembly (84) into boss on left side of rotor housing.

h. Install plug (86) in jet. Screw plug (79) into side and 90° elbow (78) into top of oil manifold so elbow points away from plug. Screw 90° elbow (70) in side of manifold above plug with open end away from plug. Screw 90° elbow (72) in front of manifold with open end down. Screw 90° elbow (8) into bottom of oil manifold.

i. Secure oil manifold (80) to bracket with two bolts (83), two washers (82) and two nuts (81).

j. Install new hot oil resistant gasket (53) (see detail B) on strainer (51) and screw strainer into outer shell assembly (52).

k. Place clamp (47) around strainer assembly (50) and secure strainer assembly to left side of oil sump and base assembly using washer (49) and bolt (48).

l. Place new O-ring (43) on bushing (42) and secure bushing in left side of oil sump and base assembly. Install O-ring (41) on flared tube bolt (39). Install bolt through tee (40). Install a second O-ring (41) on bolt and screw bolt into bushing, positioning tee horizontally.

m. Secure bracket (33) of compressor interstag housing using three bolts (36), nine washers (35) and three nuts (34).

n. Install new oil separator strainer (32) (see detail A) in body (28). With new vellumoid gasket (27) between cover and body, align cover so that axis of breather spout is 45° counterclockwise from elbow boss in side of body. Attach cover and gasket to body using six bolts (31), twelve washers (30) and six nuts (29).

NOTE

All bolts are inserted down through cover and body flanges except bolt beneath breather-spout which is installed from below flange.

o. Install nut (19) and O-ring (20) on 90° elbow (18) and screw elbow into center boss in bottom of oil separator. Screw nipple (15) into side of oil separator and screw nipple (23) into bottom of oil separator. Insert clamp (24) through bracket and secure around oil separator assembly (25) so that breather spout is toward left stack.

p. Install nut (77) and O-ring on 90° elbow (75) and screw elbow into left side of rotor housing. Install tube assembly (74) between manifold and rotor housi

q. Screw nipple (73) in bottom of oil pressure swi and attach tube assembly (71) to nipple and elbow in oil manifold.

Install tube assembly (69) between elbow on side manifold and right side of end cap on accessory ve.

Sc[illegible] 90° elbow (12) into lower boss in two-stage mpressor accessory drive housing. Place O-ring) on union and screw union (10) into second stage using. Install tube assembly (9) on elbow and union.

Install manifold to compressor tube assembly (7) 90° elbow at bottom of oil manifold. Screw nipple in upper boss on two-stage compressor accessory ve housing. Install cross (3) on compressor tube sembly (7) and attach tube assembly (1) to cross and ple. Slip clamp (5) around tube assembly (7) and cure clamp to right side of oil sump and base assem- using spacer (6) and bolt (4).

Screw 90° elbow (45) into bushing (46) at scavenge et port of lube and scavenge pump. Install hose sembly (44) between 90° elbow and oil strainer as- mbly at left side of oil sump and base assembly.

Place nut (60) and O-ring (59) on 90° elbow (58) d screw elbow into front of oil sump and base. In- ll tube assembly (57) between oil sump and base tion and lube and scavenge pump.

Slip clamp (37) around tube assembly (38) and ach tube assembly to 90° elbow at bottom of oil eather body and to tee (40).

Place O-ring (56) on union (55) and screw union o second-stage housing. Attach tube assembly (54) union and to oil strainer assembly (50).

Install tube assembly (22) between oil separator d tee (40). Slip clamp (21) around tube assembly d attach clamp with bolt at lower left side of front nge of compressor interstage housing.

Sc[illegible] 45° elbow (17) into top of second-stage using. Install tube assembly (16) between oil parator and elbow.

a. Screw 45° elbow (14) in top of rotor housing. stall tube assembly (13) between 45° elbow and pple in oil separator.

-10. FUEL SYSTEM.

-11. INSTALLATION. (See figure 4-3.) The fuel stem should be installed in the following manner:

a. Secure solenoid assembly bracket (90) to right de of accessory drive cover with two washers (93), o washers (92) and two bolts (91).

b. Secure fuel solenoid (84), with flow arrow pointing rward, using two bolts (89), two short spacers (88) ositioned against bolt heads), two long spacers (87) ositioned between solenoid and bracket), two washers 6), and two nuts (85).

c. Secure high pressure fuel filter (81) to solenoid acket with two bolts (82) and two spacers (83).

d. Place nut (79) and O-ring (80) onto 45° elbow (78) id screw elbow into bottom drain port of fuel pump. ttach tube assembly (77) to elbow. Place new gasket 6) over studs of mounting pad on accessory drive ssembly. Lower fuel pump and governor assembly 3), with drain tube attached, into position over studs accessory drive mounting pad and secure with four ashers (75) and four nuts (74).

e. Place two O-rings (72) onto bushings (71) and screw bushings into "in" and "out" ports in head of high pressure fuel filter. Place nut (69) and O-ring (70) onto 90° elbow (68) and screw elbow into bushing in "in" port of fuel filter. Place O-ring (67) onto union (66) and screw union into pump outlet port. Install hose assembly (65) between union and elbow.

f. Place nut (63) and O-ring (64) onto tee (62) and screw tee into inlet port of fuel solenoid. Place O-ring (61) and nut (60) onto 90° elbow (59) and screw elbow into port on top of governor. Install hose assembly (58) between elbow and tee.

g. Install nut (56) and O-ring (57) onto 45° elbow (55) and screw elbow into bushing in "out" port of high pressure fuel filter. Install nut (53) and O-ring (54) on 90° elbow (52) and screw elbow in governor fuel inlet port.

NOTE

The port in the governor opposite the inlet port is plugged in this configuration.

Install clamp (50) around hose assembly (51) and install hose assembly between 90° elbow and 45° elbow. Install nut (48) and O-ring (49) on tee (47) and screw tee into outlet port of fuel solenoid. Place nut (45) and O-ring (46) onto 90° elbow (44) and screw elbow into boss in right-hand burner elbow. Install tube assembly (43) between tee and 90° elbow. Place nut (41) and O-ring (42) onto 90° elbow (40) and screw elbow into left-hand burner elbow. Install clamps (38 and 37) around hose assembly (39) and install hose assembly between tee and 90° elbow. Secure clamp (37) to clamp on lube line with screw (36) and nut (35).

h. Secure acceleration limiter bracket (29) to accessory drive cover with two washers (34), two washers (33) and bolt (31). Insert long bolt (30) through clamp (50), spacer (32) and washers (34 and 33), and screw bolt into accessory drive cover.

i. Install acceleration limiter on bracket (29) with two spacers (27), washers (26), bolts (28) and nuts (25). Place O-ring (23) onto union (22) and screw union into center drainage port of acceleration limiter. Place nut (20) and O-ring (21) onto 90° elbow (19) and screw elbow into upper port of acceleration limiter. Place nut (17) and O-ring (18) onto 90° elbow (16) and screw elbow into air bleed boss in rear compressor case. Install hose assembly (15) between elbow. Place nut (13) and O-ring (14) onto 90° elbow (12) and screw elbow into center port of tee attached to fuel solenoid. Place nut (10) and O-ring (11) on 45° elbow (9) and screw elbow into lower port of acceleration limiter. Attach hose assembly (8) to elbows. Position clamp (7) around hose assembly between fuel solenoid and acceleration limiter and secure with center bolt attaching front engine hoist fitting. Place O-ring (6) on upstream end of check valve (5) and screw check valve into by-pass port of acceleration limiter. Place nut (3) and O-ring (4) on tee (2) and screw tee into pump inlet port. Install tube assembly (1) between acceleration limiter and tee.

8-12. ACCEPTANCE TESTING OF ENGINE.

8-13. GENERAL. After final assembly, the Model 502-7D Gas Turbine Engine should be acceptance tested for proper operation and performance. The special equipment required, instructions for installatio.. in a test bed, operating procedures and precautions, and means for determining and obtaining correct engine performance are described in paragraph 8-14 through 8-23.

8-14. SPECIAL TOOLS AND EQUIPMENT: (See figure 8-3.) No special tools are required. The special equipment described in this paragraph is required for acceptance testing the engine and should be installed in accordance with the following instructions:

a. Mount engine in suitable test bed designed to support the unit employing the three engine mounting brackets and engine mounts (see figure 4-2, items 42, 43, 44, 45 and 46). The engine should be easily accessible from the sides, top and bottom.

b. Install 5.25 inch diameter ASME nozzle on inlet flange of gas producer compressor. Mount oil cooler, part number 8518911, Harrison Radiator Division, General Motors Corp., to the inlet of compressor by means of transition duct similar to part number 5-90753 Boeing Airplane Co.

c. The test equipment should be arranged so that exhaust gases do not re-enter the engine or compressor inlets. Air temperatures at both air inlets should be approximately equal; however special exhaust ducting will ordinarily be required only if the unit is being tested in a cell or closed area. In this case the gas producer air inlet duct should be large enough to fit over the 5.25 inch diameter ASME nozzle bell. A 12-inch diameter duct should be provided to the oil cooler for the two-stage compressor inlet air. Two nine-inch diameter exhaust stacks should be provided to slip over the exhaust collector outlets. These stacks should be externally supported so that they will not apply force either vertically or horizontally against the exhaust collector. They should be tall enough to assure complete dissipation of exhaust gas to atmosphere.

d. The engine oil system (see figure 6-6) should be connected in the following manner:

1. Mount the lube filter (24) near the engine and connect its inlet to the discharge port of the pressure (upper) section of the lube and scavenge pump (18) by means of 5/16-inch inside diameter flexible hose.

2. The outlet of the oil filter should be connected to the cross fitting near the two-stage compressor air inlet by means of 5/16-inch inside diameter flexible hose.

3. The oil pressure gage (1) should be connected to the cross described in step d-2 above, by means of 5/16-inch inside diameter flexible hose (see Table XVI).

4. A 13/32-inch inside diameter flexible hose should connect the inlet of the oil cooler (3) to the discharge port of the scavenge (lower) section of the lube and scavenge pump.

5. A 5/16-inch diameter flexible hose should connect the outlet of the oil cooler to a boss on the right side of the rotor housing (25).

e. Fuel (specification MIL-F-5624A, JP-4) should be supplied to the engine at a boost pressure of 3 psi through the fuel filter (52, figure 4-1) and a manual shutoff valve. A 5/16-inch diameter flexible hose should be used for a fuel supply line. Three 3/16-inch inside diameter fuel drain lines should be connected to the drain ports of the acceleration limiter, fuel pump and nozzle box, and discharged into a suitable container.

f. Connect a 24 volt dc source of power to following electrical equipment as shown in figure 8-4. Items 1 through 6 below should be installed on the control panel; items 7 through 14 are installed near or on the engine.

1. Circuit breaker (30 amp).
2. DC power switch (single pole, single throw).
3. Start switch (single pole, single throw, momentary on).
4. Fuel switch (single pole, single throw, momentary on).
5. Low oil pressure warning light.
6. Tachometer indicator (figure 4-1, item 54).
7. Starter relay (figure 4-1, item 49), located near engine on test stand.
8. Voltage regulator (figure 4-1, item 50) located near engine on test stand.
9. Starter-generator.
10. Igniter coils (two).
11. Vapor spark plugs (two).
12. Fuel solenoid valve.
13. Oil pressure switch.
14. Tachometer generator.

g. The speed adjusting lever of the governor should be connected to a throttle on the control panel by means of suitable linkage.

h. The bypass valve of the air flow control assembly (figure 4-2, item 17) should be provided with an exhaust tube similar to part number 5-90743, Boeing Airplane Co., to direct bypassed air to atmosphere near the engine exhaust stacks. A freely hinged cap should be installed on the top of the bypass valve exhaust tube to serve as a means of determining when the air flow control assembly is bypassing air (see figure 8-3). The outlet end of the air flow control assembly should be connected to a discharge tube that terminates in a three-inch ASME nozzle (see figure 8-3). The discharge tube should be built and instrumented in accordance with ASME power test codes. Instruments required are listed in Table XVI. A manually controlled butterfly valve should be installed in the discharge tube, with linkage provided to a handle on the control panel.

i. The vibration measuring equipment listed in Table XVI should be installed as follows:

1. Attach one vibration pickup securely to the right side of the compressor casing assembly by means of the second and third compressor casing bolts above the burner elbow. The pickup should be adjusted for horizontal response and should be installed with the lead entering at the bottom.

2. Attach the second vibration pickup to the forward side of the vertical first-stage compressor outlet on the right side of the two-stage compressor by means of two of the compressor housing bolts. The pickup should be adjusted for horizontal response and should be installed with the lead entering at the bottom.

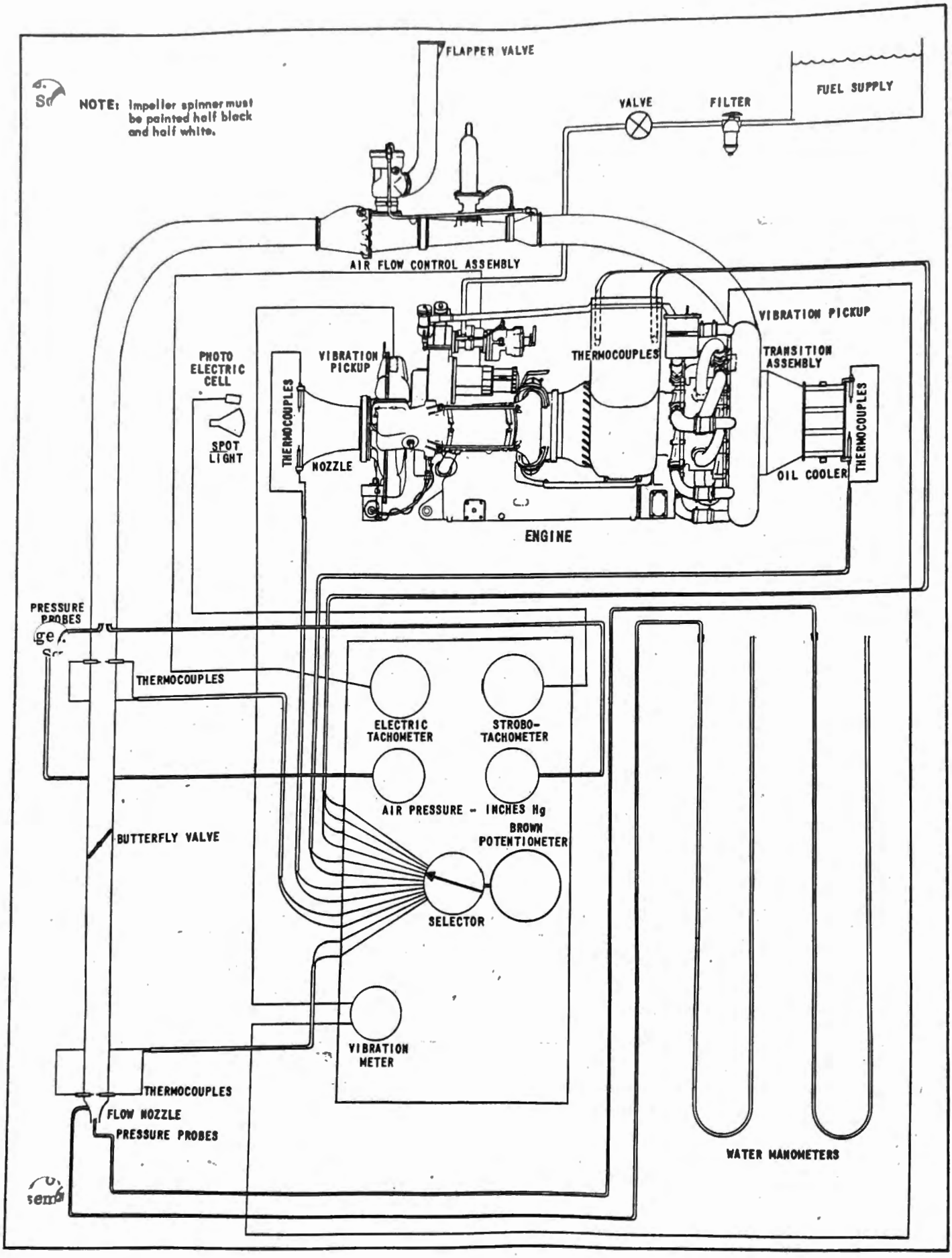


FIGURE 8-3. ACCEPTANCE TESTING INSTRUMENTATION (SEE TABLE XVI)

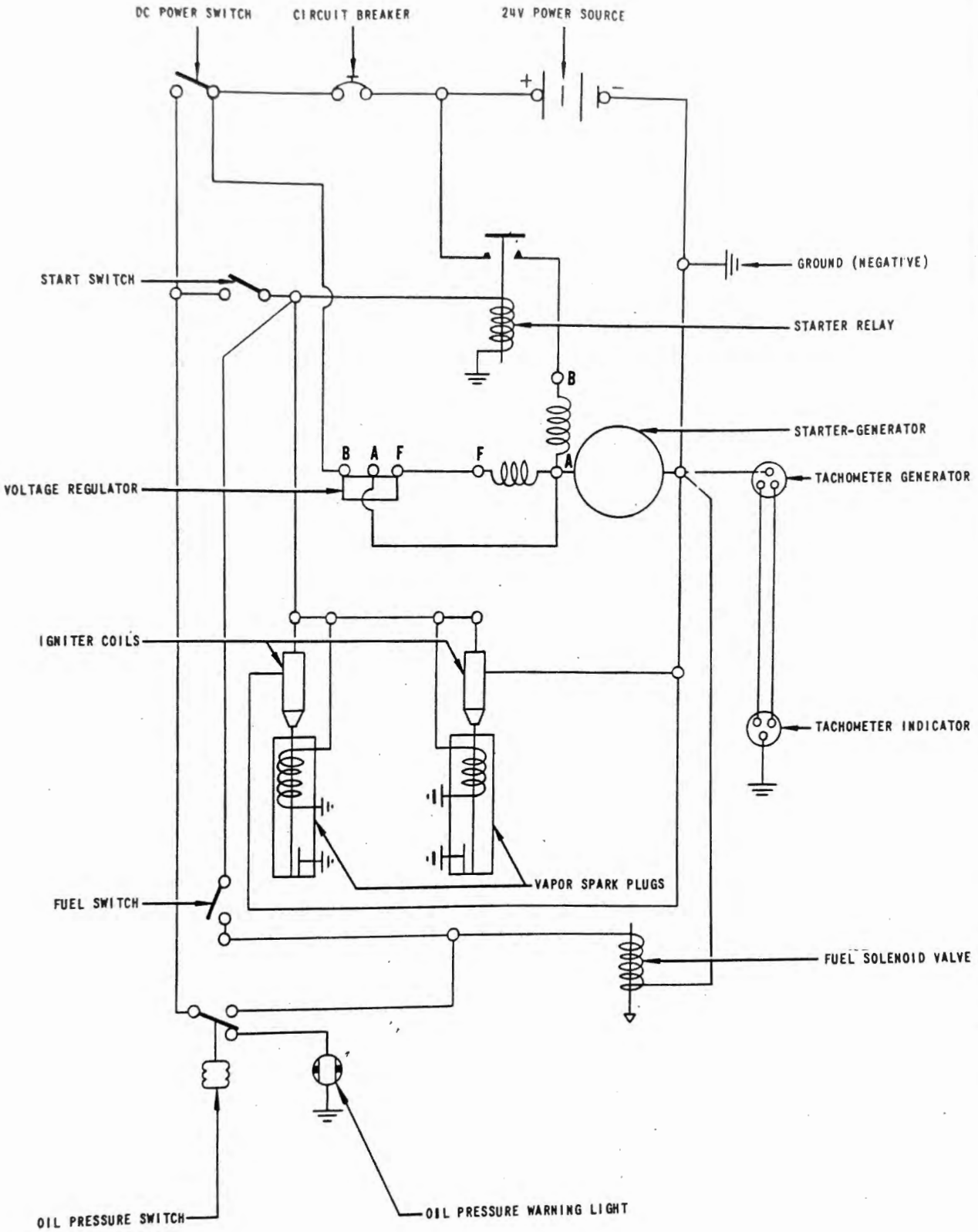


FIGURE 8-4. ACCEPTANCE TEST WIRING DIAGRAM

3. Connect the gas producer vibration pickup to t No. 1 on the vibration meter and connect the two-ge compressor vibration pickup to input No. 2 on the rati[illegible]eter.
4. System must be properly grounded.

NOTE

All instruments used on the test stand should be calibrated at least once each 30 days, or more often if required. Calibration accuracy range is noted in Table XVI. Check manometers for contaminated liquid and air leaks in lead tubes.

15. OPERATION PRECAUTIONS. Precautions necsary for the safe operation of gas turbine engines e similar to those for reciprocating engines. Hower, for gas turbine engines, special consideration ould be given to inlet air points and exhaust outlets well as the relatively high engine speeds and temratures. The following safety precautions must ways be observed:
. Keep hands, clothing, waste, or any combustible aterial away from open ends of exhaust stack assemies.
.. Keep hands, clothing, waste or any foreign material ear of the air inlets.
c. Do not touch the exhaust stack assemblies with are [illegible]s during or immediately after operation of ngine.
d. Do not touch burner shell, nozzle box, nozzle ring, xhaust collector assemblies and adjacent parts during r immediately after operation of engine.
e. At rated speed, do not occupy areas adjacent to lane of rotation of impellers or turbine wheels. Impeller or turbine wheel failure may shatter the housings which surround them. A blade thrown from one of the urbine wheels, however, will generally be discharged pward through one of the exhaust stack assemblies.

8-16. PRESTARTING PROCEDURES. After installaion of the engine and its instrumentation is complete, perform the following operations:
a. Make a general overall inspection of engine for security of parts and remove any rags or fire hazards.
b. Connect pressurized source of lubricating oil (MIL-O-2104, SAE 10) to inlet of oil filter and prelubricate engine by pumping approximately 1-1/2 quarts of oil into system.
c. Fill oil supply reservoir to full mark on dipstick. Do not overfill.
d. Bleed all air from fuel system by disconnecting fuel lines at burner elbows and energizing starter with fuel valves open and fuel boost pump on until solid stream of fuel flows from fuel lines. Reconnect fuel lines to burner elbows. Observe starter limitations described in paragraph 8-18.
e. Recheck oil level with dipstick and add oil as necessary to fill supply reservoir.

8-17. STARTING PROCEDURE. After prestarting procedures have been completed, the engine should be started in the following manner:
a. Open fuel line shutoff valves between fuel tank, boost pump and fuel pump assembly inlet port.
b. If fuel boost pump is used, start pump.
c. Move "DC POWER" switch to ON. Low oil pressure light will illuminate.
d. Move "START" switch to ON position and hold it there.

NOTE

If tachometer indicator does not register 4000 rpm within ten seconds, release "START" switch and turn off "DC POWER" switch. Troubleshoot engine as described in paragraph 8-23.

e. When tachometer indicator registers 4000 rpm and with "START" switch still in the ON position, move "FUEL" switch to the ON position. Engine should fire and tachometer indicator reading should increase to approximately 15,000 rpm within seven seconds.

NOTE

If acceleration to idling speed does not occur within seven seconds after "FUEL" switch has been actuated, an abnormal start has occurred. Release "START" and "FUEL" switches simultaneously and turn off "DC POWER" switch. Move "DC POWER" switch to ON, turn on "START" switch and hold for a few seconds to clear combustion chambers and to allow any accumulated fuel to drain from nozzle box assembly.

f. Observe oil pressure gage. Pressure should be at least 20 psi at 15,000 rpm. If no oil pressure is registered at 15,000 rpm, release "START" and "FUEL" switches simultaneously and turn off "DC POWER" switch. Troubleshoot engine as described in paragraph 8-23 before attempting further operation.
g. If a normal start has occurred, and "LOW OIL PRESS" indicator light goes out when tachometer registers approximately 15,000 rpm, release "START" and "FUEL" switches simultaneously.

NOTE

Premature release of "START" or "FUEL" switches will cause automatic shutdown of engine.

8-18. STARTING PRECAUTIONS. The following limitations for operation of starter-generators should be observed. (The starter-generator is designed for intermittent duty only, and the following restrictions must be observed to avoid overheating.)
a. The external source of dc power must not exceed 24 volts at the starter terminals.

TIME	(1) TURBINE SPEED (ELECTRIC)	(2) TURBINE SPEED (STROBE)	(3) OIL PRESSURE psig	(4) GAS PRODUCER AIR INLET TEMPERATURE —°F		(5) EXHAUST TEMPERATURE—°F				(6) COMPRESSOR AIR INLET TEMPERATURE —°F		(7) DELIVERED TOTAL AIR PRESSURE — IN Hg ABS.		(8) DELIVERED AIR TEMPERATURE —°F		(9) AIR FLOW NOZZLE TEMPERATURE —°F		(10) AIR FLOW NOZZLE TOTAL PRESSURE — IN. H_2O G	(11) AIR FLOW NOZZLE STATIC PRESSURE — IN. H_2O G	(12) GAS PRODUCER VIBRATION	(13) COMPRESSOR VIBRATION
	rpm	rpm		T_1	T_2	T_9	T_{10}	T_{11}	T_{12}	T_3	T_4	P_1	P_2	T_5	T_6	T_7	T_8	P_3	P_4	Z_G	Z_C

TABLE XVI INSTRUMENTATION

Item	Pickup	Indicator	Data Obtained	Units
1	Tachometer Generator	Tachometer indicator (Figure 4-1, item 54)	Turbine speed	RPM
2	Strobe light, or photo-electric cell and spotlight	Strobotach indicator, 0 - 40,000 range	Turbine speed	RPM
3		Oil pressure gage, 0 - 150 psi range	Oil pressure	psig
4	Iron-constantan thermocouples, (2 required)	See Note A	Gas producer air inlet temperature, T_1 and T_2	°F
5	Chromel-alumel thermocouples, (4 required)	See Note A	Exhaust temperature, T_9, T_{10}, T_{11}, and T_{12}	°F
6	Iron-constantan thermocouples, (2 required)	See Note A	Compressor air inlet temperature, T_3 and T_4	°F
7	Pressure probes (2 required)	Gage, 0 - 200 in. Hg range	Delivered total air pressure, P_1 and P_2	In. Hg abs.
8	Iron-constantan thermocouples (2 required)	See Note A	Delivered air temperature, T_5 and T_6	°F
9	Iron-constantan thermocouples (2 required)	See Note A	Air flow nozzle temperature, T_7 and T_8	°F
10	Pressure probe	Water manometer, 0 - 100 in. H_2O range	Air flow nozzle total pressure, P_3	In. H_2O gage
11	Pressure probe	Water manometer, 0 - 100 in. H_2O	Air flow nozzle static pressure, P_4	In. H_2O gage
12	Vibration pickup See Note B	See Note C	Gas producer vibration indicator reading, X_G	-
13	Vibration pickup See Note B	See Note C	Two-stage compressor vibration indicator reading, X_C	-

Note A: Brown Potentiometer-Pyrometer, Model Y156X(15)P-X-(L)(V). Minneapolis-Honeywell, Brown Instrument Division, Philadelphia, Penn.

Note B: MB Vibration Pickup, Type 126. MB Manufacturing Co., New Haven, Conn.

Note C: MB Vibration Meter, Type VM3. MB Manufacturing Co., New Haven, Conn.

TABLE XVII PERFORMANCE TEST OPERATING LIMITS

	Condition	Minimum	Normal	Maximum
TURBINE SPEED	Cranking	4,500 rpm	-	-
	Idling	14,800 rpm	15,000 rpm	16,000 rpm
	Rated speed	-	-	*36,500 rpm
FUEL PRESSURE	Starting	40 psi	-	45 psi
	Rated speed	-	350 psi	450 psi
OIL PRESSURE	Idling	20 psi	-	-
	Rated speed	35 psi	60 psi	80 psi
EXHAUST TEMPERATURE	Continuous rating	-	-	649°C (1200°F) See Note A 677°C (1250°F) See Note B 52°C (125°F) See Note C
COMPRESSOR AIR TEMPERATURE	Continuous	-	-	232°C (450°F)

Note A: 1200°F average of measurement from four thermocouples

Note B: 1250°F maximum from any one thermocouple

Note C: 125°F maximum variance between thermocouples

*If EGT permits. Set high speed stop at 35,000 rpm at conclusion of acceptance test.

b. The starter should not be energized for a period greater than 15 seconds at any one time.

c. Each series of two starting attempts should be followed by a cooling period of 10 minutes minimum.

d. After three unsuccessful starting attempts, the fuel and ignition systems should be checked for malfunction in accordance with paragraph 8-23.

e. During consecutive starting attempts, the starter should be checked by "feel" to be sure it is not overheating.

8-19. OPERATIONAL CHECKS. The operational checks listed in this paragraph form a part of the performance acceptance test. Any discrepancies should be noted on the test data sheet.

a. Make the following functional checks with the engine running at idle. Credit running time accumulated against scheduled idling time.

1. Check instrumentation to see that all indicat are reading normally according to Table XVII
2. Set oil relief valve at 70 psi with cold
3. Check engine visually for oil leaks.
4. Check engine visually for fuel leaks.
5. Check engine for air leaks by feeling for blasts.
6. Be alert for any unusual engine sound that m telegraph poor operation.
7. Set idle speed stop for 14,800 - 16,000 r

b. Make following operational checks during or mediately following acceptance run schedule:

1. Check for unusual engine noise during acc ance run and investigate if present. Intermittent bu howl is not cause for rejection.

2. During acceptance run check for streaks of color, indicating excessively high temperature, in the nozzle box aft of the burners.

3. Record engine vibration and frequency at 36,000 rpm turbine speed.

4. Check time to accelerate from idle to rated speed while rapidly advancing throttle. Four seconds is minimum acceleration time. Do not exceed maximum exhaust temperature limits. Adjust acceleration limiter if necessary.

5. Check for burner blowout while rapidly closing throttle from rated speed. Adjust governor if necessary.

6. Check high and low speed settings of governor; adjust if necessary.

7. At idle speed, check for fuel, oil and air leaks.

8. Check crossfire starting from both sides. Start engine with one igniter coil and spark plug disconnected. If crossfiring does not occur, inspect crossfire tube for correct positioning.

WARNING

Failure to disconnect the igniter coil when spark plug is disconnected can result in damage to the igniter coil.

9. After engine is shutdown, drain oil and check oil filter and strainer screens for foreign matter. If foreign matter or metal particles are found, disassemble engine to determine cause.

8-20. ACCEPTANCE RUN. The acceptance run for the engine is as shown in Table XVIII. The engine speed settings to be run are made at the strobotach setting nearest the speed shown. Do not exceed operating limits shown in Table XVII at any time. Using data sheet similar to figure 8-5, record all instrument readings indicated. Data is recorded at each check point except 15,000 rpm under two conditions, as follows:

a. With the butterfly valve closed completely to obtain full bypass through the air flow control valve.

b. With the butterfly valve open sufficiently to attain as high a delivered total air pressure possible without allowing air to bypass from the air flow control valve. This condition is achieved by opening the butterfly valve until bypassing has ceased (flapper valve closed) then closing the butterfly valve slightly.

c. Check engine vibration at both gas producer and two-stage compressor by following the procedure outlined below, with the engine operating at 36,000 rpm and vibration equipment set up as described in paragraph 8-14, step i.

1. Turn on electrical power to vibration meter.
2. Set scale selector on vibration meter to "5."
3. Set velocity-displacement switch on vibration meter to "V."
4. Select desired vibration pickup by setting channel selector of vibration meter on appropriate channel ("1" for gas producer pickup and "2" for two-stage compressor pickup).
5. Set filter switch on vibration meter to "out."
6. Record vibration meter reading in appropriate column of Acceptance Test Data Sheet (figure 8-5).
7. Set channel selector of vibration meter to appropriate channel for second vibration pickup (see step 4 above), and repeat step 6.

TABLE XVIII. ACCEPTANCE RUN SCHEDULE

TURBINE SPEED	DURATION	OPERATION
15,000 rpm	5 minutes	Perform idle checks listed in paragraph 8-19. a.
26,000	10	Record data per figure 8-5.
31,000	10	Record data per figure 8-5.
34,000	10	Record data per figure 8-5.
36,500 *	10	Record data per figure 8-5.
15,000-36,500 *	5	Perform checks listed in paragraph 8-19. b.

* If exhaust temperature permits, otherwise on a speed at or below maximum exhaust temperature per Table XVII.

8-21. PERFORMANCE CALCULATIONS. Data recorded on the Acceptance Test Data Sheet, figure 8-5, can be applied to determine engine acceptability by following the procedures outlined below. Use the data recorded during the closed bypass run at rated speed. Enter the results of each calculation in the appropriate column of the Data Sheet. The following symbols and abbreviations are used in the performance equations given below:

g - acceleration of gravity, 32 feet/second.
H_2O - water
Hg - mercury
P - pressure
F - Fahrenheit
in. - inches
T - temperature in degrees Fahrenheit
T_2, T_7 etc. - refer to values entered in tabular form in figure 8-5.
Other symbols are defined where used.

a. Convert total pressure at flow nozzle in. H_2O gage (P_3) to in. Hg absolute (P_{TN}).

$$P_{TN} = \frac{P_3}{13.6} + P_b$$

Where P_b = barometric pressure in. Hg

b. Static pressure at flow nozzle, in. Hg absolute (P_{SN}).

$$P_{SN} = \frac{P_4}{13.6} + P_b$$

NOTE

Except in certain test cell installations, the value of P_4 is extremely small, and P_{SN} is generally derived without measuring P_4, as follows:

$$P_{SN} = P_b$$

c. Calculated flow nozzle pressure ratio.

$$\frac{P_{SN}}{P_{TN}}$$

d. Calculate temperature at flow nozzle (T_N).

$$T_N = \frac{T_7 + T_8}{2} \ ^\circ F$$

e. Find delivered air flow, lb per second (W_a), by using figure 8-6 as follows:

1. Enter at P_{TN} (from step a)
2. Read up to T_N (from step d)
3. Read across to $\frac{P_{SN}}{P_{TN}}$ (from step c)
4. Down to W_a

f. Calculate delivered total pressure in atmospheres (P_{TD}).

$$P_{TD} = \frac{\frac{P_1 + P_2}{2}}{P_b} \text{ atmospheres}$$

g. Calculate delivered air temperature, °F (T_D).

$$T_D = \frac{T_5 + T_6}{2} \ ^\circ F$$

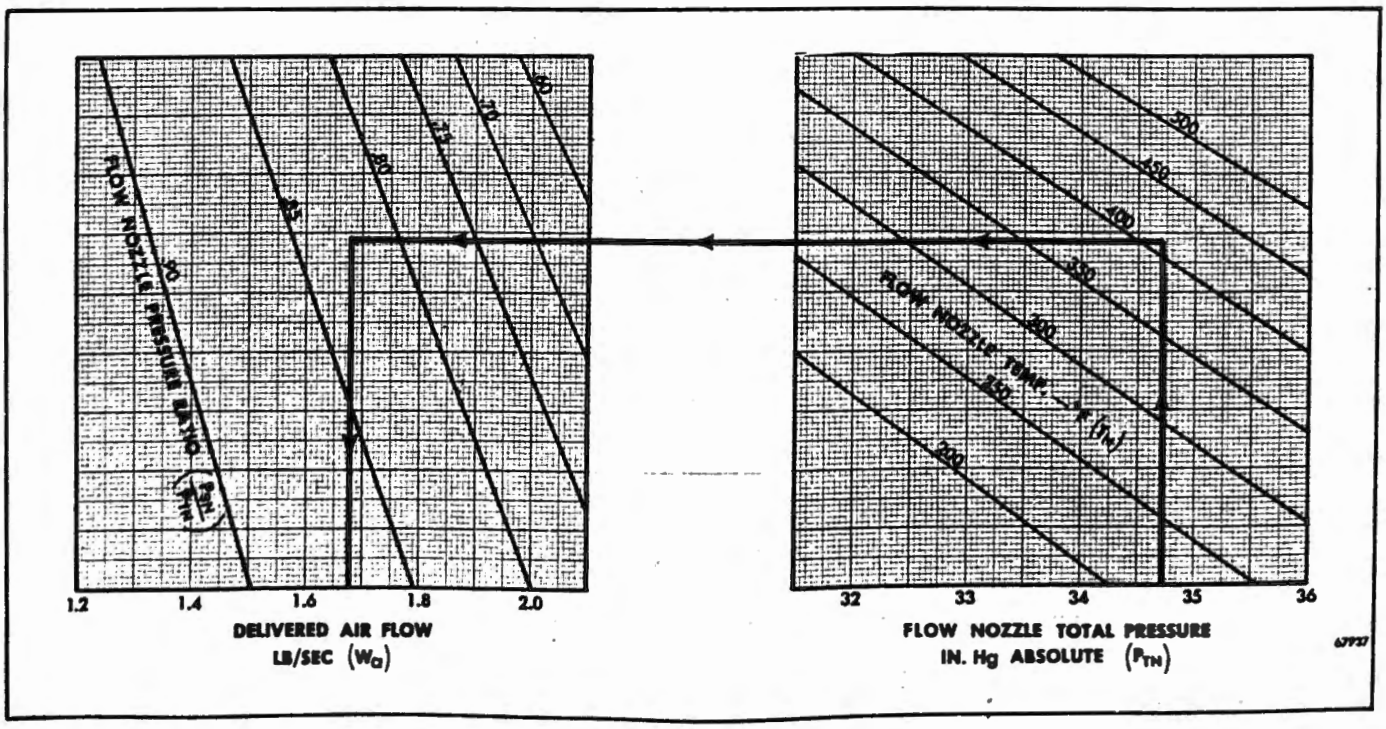


FIGURE 8-6. DELIVERED AIR FLOW

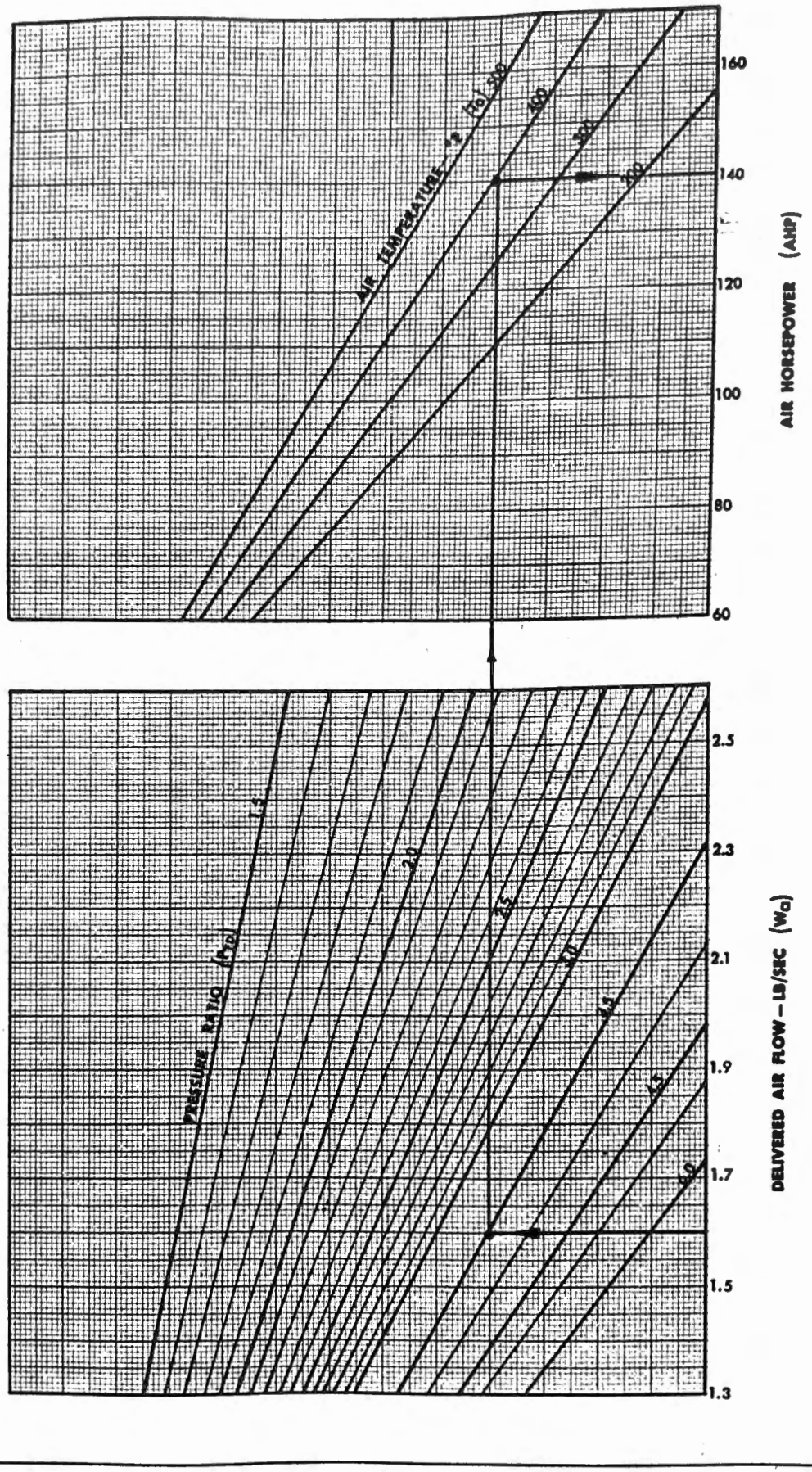


FIGURE 8-7. AIR HORSEPOWER

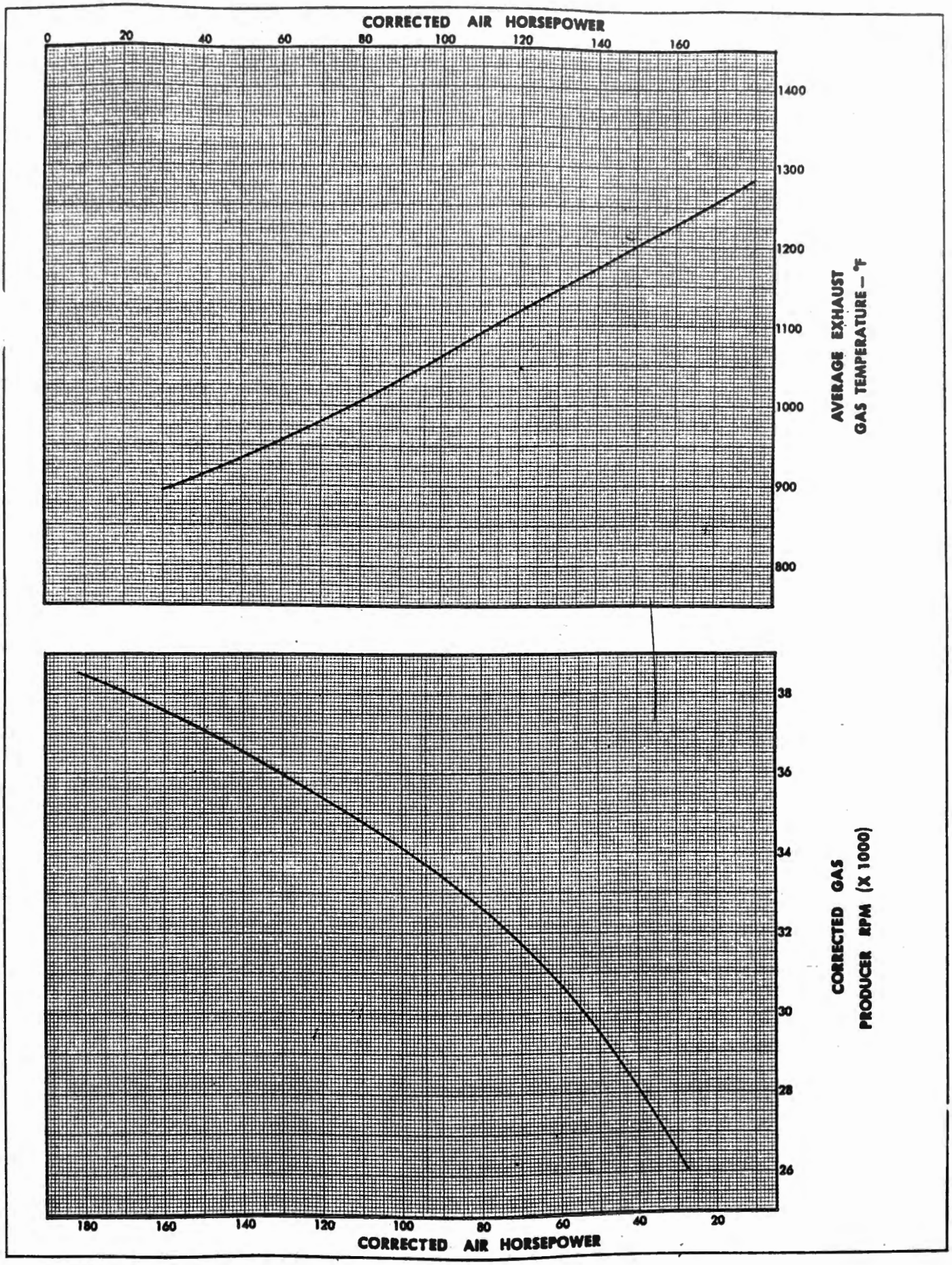


FIGURE 8-8. ENGINE ACCEPTABILITY

h. Find air horsepower (AHP) by using figure 8-7, as follows:

1. Enter at W_a (from step e)
2. Read left across to P_{TD} (from step f)
3. Read up to T_D (from step g)
4. Read right across to AHP.

i. Determine barometric correction factor ( ).

$$\delta = \frac{P_b}{29.92}$$

j. Calculate air temperature, °F (T_a).

$$T_a = \frac{T_3 + T_4}{2} \quad °F$$

k. Determine temperature correction factor (θ).

$$\theta = \frac{T_a + 460}{520}$$

l. Correct AHP to standard conditions.

$$\text{AHP (corrected)} = \frac{\text{AHP}}{\delta\sqrt{\theta}}$$

m. Correct turbine speed (rpm) to standard conditions.

$$N \text{ (corrected)} = \frac{\text{rpm}}{\sqrt{\theta}} \quad \text{rpm}$$

n. Calculate average exhaust temperature, °F (T_E).

$$T_E = \frac{T_9 + T_{10} + T_{11} + T_{12}}{4} \quad °F$$

o. Correct T_E to standard conditions.

$$T_E \text{ (corrected)} = \frac{T_E + 460}{\theta} - 460 \quad °F$$

p. Using figure 8-8, check for engine acceptability as follows:

1. Plot AHP corrected (from step l) against N corrected (from step m) on lower curve of figure 8-8. This point must fall to the left of the curve for engine acceptability. Enter in data sheet whether point is satisfactory or unsatisfactory.
2. Plot AHP corrected (from step l) against T_E corrected (from step o) on upper curve of figure 8-8. This point must fall to the right of the curve for engine acceptability. Enter in data sheet whether point is satisfactory or unsatisfactory.

8-22. PERFORMANCE ACCEPTABILITY. To be acceptable, the engine must have satisfied the following minimum requirements.

a. 140 AHP corrected to standard conditions of 15°C (60°F) inlet air temperature and 29.92 inches of mercury barometric pressure, without exceeding the operating limits specified in Table XVII.

b. Vibration load of the gas producer and two-stage output compressor (G_G and G_C) shall not exceed 15 "g."

c. Engine shall have complied with the operational checks listed in paragraph 8-19.

NOTE

In the event of failure of the engine to satisfy any of the above requirements, consult paragraph 8-23 for possible causes and recommended corrective action.

8-23. TROUBLE SHOOTING. Troubles which may affect performance of the engine, along with probable causes and remedies, are listed in the troubleshooting guide, Table XIX.

TABLE XIX - TROUBLE SHOOTING GUIDE

TROUBLE	PROBABLE CAUSE	REMEDY
ENGINE FAILS TO CRANK		
("LOW OIL PRESS" indicator light is out)	"DC POWER" switch off	Turn "DC POWER" switch on
	Circuit breaker out	Reset circuit breaker
(Open circuit between battery and starter-generator)	Battery disconnected	Connect battery
	Faulty switches and components	Check operation and circuitry of "DC POWER" and "START" switches, circuit breaker, starter relay; replace any faulty components

TABLE XIX - TROUBLE SHOOTING GUIDE

TROUBLE	PROBABLE CAUSE	REMEDY
	Faulty wiring or connections	Check continuity of wiring between components of start circuit; check security of connections; replace defective wiring
(Electric power available at starter)	Faulty starter-generator	Check to see if balancing assembly turns freely; if balancing assembly turns freely, replace starter-generator.
	Faulty accessory drive assembly	If balancing assembly will not turn freely, remove accessory drive assembly; check for bind in accessory drive assembly and if defective, replace
ENGINE CRANKS BUT FAILS TO REACH 4000 RPM		
(Low voltage at starter-generator terminals)	Low battery voltage	Recharge or replace battery, or use 24 volt dc external power
	High resistance across starter relay contacts	Clean starter relay contacts or replace starter relay
(Normal voltage at starter-generator terminals)	Faulty starter-generator	Replace starter-generator
	Faulty or improperly installed gas producer section components	If scraping noise is heard while engine is being cranked or is decelerating, disassemble gas producer section of engine and replace faulty components
ENGINE CRANKS BUT FAILS TO START		
(No fuel available to engine)	Improper starting procedure	Restart engine
	Low fuel supply	Fill fuel tank
	Fuel supply line obstructed	Open fuel supply line valves on control panel; disconnect fuel supply line from engine fuel pump inlet; if no fuel flow appears, check for clogged filter and lines
(Faulty ignition system)	Faulty vapor spark plug	Check spark plug assembly operation, as described in paragraph 5-4; replace spark plug assembly if glow coil is broken or shorted to ground
	No spark across vapor spark plug terminals	Remove spark plug assembly and hold securely against engine surface to insure good grounding of circuit; energize starter to check spark across terminals; if no spark is apparent, disconnect high tension lead from spark plug and hold approximately 1/16 inch from bare engine surface; energize starter to check for output from igniter coil; if no spark is apparent, check electrical circuit

TABLE XIX - TROUBLE SHOOTING GUIDE

TROUBLE	PROBABLE CAUSE	REMEDY
		to igniter coil; replace vapor spark plug assembly or igniter coil if faulty
(No fuel available at burner elbows)	Air in fuel system or faulty fuel solenoid	Bleed fuel system; if no fuel is discharged from fuel nozzle hoses, disconnect hose from inlet to fuel solenoid, and energize starter; if fuel flows from hose, check fuel solenoid as described below
	Faulty fuel solenoid	Check for electrical power at fuel solenoid connection; if power is available, but solenoid does not open, replace fuel solenoid
	Faulty fuel pump on fuel pump and governor assembly	If fuel is not available at fuel solenoid inlet (see above), disconnect hose from fuel governor assembly and energize starter; if fuel flows from fuel line, replace fuel pump and governor assy
	Faulty or dirty high pressure fuel filter	If no fuel flows from governor inlet line, disconnect inlet hose from high pressure fuel filter, and energize starter; if fuel flows from filter inlet hose, clean or replace high pressure fuel filter
	Faulty governor on fuel pump and governor assembly	If fuel is not available at high pressure fuel filter inlet but is available at fuel pump inlet, replace fuel pump and governor assembly
(Fuel available at burner elbows)	Faulty ignition system	See above
	Faulty pressure relief valve	Replace pressure relief valve
	Clogged fuel nozzles	Disassemble burners and clean or replace fuel nozzles
ENGINE STARTS BUT FAILS TO ACCELERATE TO IDLING SPEED WITHIN SEVEN SECONDS		
(One burner start, but engine does not crossfire)	Faulty ignition system	Check ignition system, as described under "ENGINE CRANKS BUT FAILS TO START"
(Restricted fuel flow)	Obstruction in fuel system lines or components	Check fuel system as described under "NO FUEL AVAILABLE AT BURNER ELBOWS" and "ENGINE CRANKS BUT FAILS TO START"
	Improperly adjusted governor	Adjust governor on fuel pump and governor assembly
	Clogged fuel nozzle	Disassemble burners and clean or replace fuel nozzles

TABLE XIX - TROUBLE SHOOTING GUIDE

TROUBLE	PROBABLE CAUSE	REMEDY
ENGINE SHUTS DOWN WHEN "FUEL" AND "START" SWITCHES ARE RELEASED ("LOW OIL PRESS" indicator light on)	Improper starting procedure	Restart engine, following procedure described in paragraph 8-17
	Faulty oil pressure switch	If oil pressure gage registers above 20 psi and "LOW OIL PRESS" indicator light is on when engine shuts down, replace oil pressure switch
	Faulty lubrication and scavenge pump	If oil pressure gage registers below 20 psi and "LOW OIL PRESS" indicator light is on when engine shuts down, check oil supply; if oil supply is sufficient, disconnect hose assembly at oil filter inlet; crank engine and check for oil flow from lubrication and scavenge pump; replace defective pump
	Oil filter clogged	If oil flows from pump, check oil filter and connecting hose for obstruction; replace or clean oil filter
	Faulty accessory drive assembly	Disconnect hose from pressure discharge port of lubrication and scavenge pump; crank engine and observe through pump port whether pump is rotating; if pump does not turn, replace accessory drive assembly and check engine oil system for foreign particles
	Faulty lubrication and scavenge pump	If lubrication and scavenge pump rotates but does not pump oil, replace pump
ENGINE REACHES IDLING SPEED BUT FAILS TO ACCELERATE PROPERLY (Maximum speed approximately 25,000 rpm)	Acceleration limiter drain line clogged	Clear line
	Acceleration limiter drain line clogged with ice or foreign material	Clean or thaw limiter drain line
	Faulty acceleration limiter	Replace acceleration limiter
(Maximum speed above 25,000 rpm)	Faulty or improperly adjusted throttle installation	Visually inspect to see that governor control arm reaches high speed stop; adjust or replace faulty components
	Faulty acceleration limiter	Install manually operated valve in line between fuel solenoid and acceleration limiter; open valve and start engine; close valve and slowly accelerate engine; if previous con-

TABLE XIX - TROUBLE SHOOTING GUIDE

TROUBLE	PROBABLE CAUSE	REMEDY
		ation is eliminated, replace acceleration limiter
	Faulty fuel pump and governor assembly	If above test does not eliminate trouble, replace fuel pump and governor assembly
	Improperly adjusted acceleration limiter	Adjust acceleration limiter
(Air pressure gage indicates low)	Faulty air flow controller	Check position of exhaust tube hinged cap to determine if air is being bypassed
	Air leakage around power package air ducts or clamps	Inspect mating surfaces of ducts and clamps; repair or replace faulty components
	Low engine power	See high exhaust temperature checks under "ENGINE SHUTS DOWN" above; see acceleration limiter, and fuel pump and governor assembly checks under "ENGINE REACHES IDLING SPEED BUT FAILS TO ACCELERATE PROPERLY" above
	Air inlets partially covered	Remove foreign objects from inlet screens
COMPRESSOR SURGE	Faulty air flow controller	Replace air flow controller assembly
EXCESSIVE ENGINE OIL LOSS	Leakage around air seal	Replace air seal and clean out pressurizing passage
(Oil running from behind inner cone assembly)	Faulty scavenge section of lubrication and scavenge pump	Replace faulty lubrication and scavenge pump
	Scavenge line strainer clogged	Disassemble and clean strainer
	Loose fittings in scavenge line	Tighten fittings, as required
OIL IN DELIVERED AIR	Oil leakage around accessory drive cover at rear of output compressor section	Tighten accessory drive cover
	Oil leakage around fittings installed on output compressor section	Check oil supply lines and connections; tighten connections or replace hose assemblies
VIBRATION ABOVE ACCEPTABLE LIMIT	Improperly installed or unbalanced balancing assembly	Install balancing assembly properly or replace balancing assembly
ENGINE OPERATING OVER LIMITS		
(High exhaust temperature)	Improper operating procedure	Operate power set assembly in accordance with operating limits
	Faulty exhaust temperature gage or circuit	Calibrate exhaust temperature circuit

TABLE XIX - TROUBLE SHOOTING GUIDE

TROUBLE	PROBABLE CAUSE	REMEDY
	Gas leakage around crossfire tube connections or gaskets and seal rings on burner shell assemblies	Check for leakage in vicinity of crossfire tube and burner shells; tighten both clamps to 60 lb-in; if leakage persists, replace defective parts
	Faulty gas producer section	Disassemble gas producer section and replace defective parts
("LOW OIL PRESS" indicator light on at moment of shutdown)	Low engine oil level; see also "EXCESSIVE ENGINE OIL LOSS" below	Replenish engine oil supply
	Dirty oil cooler assembly, or high ambient temperature	Remove and clean oil cooler assembly
	Oil filter clogged	See "Oil filter clogged" under "ENGINE SHUTS DOWN WHEN 'FUEL' AND 'START' SWITCHES ARE RELEASED" above
	Faulty accessory drive assembly	See Faulty accessory drive assembly under "ENGINE SHUTS DOWN WHEN 'FUEL' AND 'START' SWITCHES ARE RELEASED" above
	Faulty lubrication and scavenge pump	See "Faulty lubrication and scavenge pump" under "ENGINE SHUTS DOWN WHEN 'FUEL' AND 'START' SWITCHES ARE RELEASED" above
FLAME OUT DURING DECELERATION	Incorrect governor adjustment	Adjust minimum flow needle valve on fuel pump and governor assembly
ABNORMAL INSTRUMENT INDICATION		
(Engine rpm erratic or falls off)	Faulty tachometer generator or tachometer indicator	If engine operation and other instrument readings appear to be normal, check tachometer generator, tachometer indicator, and connecting wiring; replace faulty components
	Faulty fuel pump and governor assembly, or acceleration limiter	Check fuel pump and governor assembly and acceleration limiter as described in "Maximum speeds above 25,000 rpm" under "ENGINE REACHES IDLING SPEED BUT FAILS TO ACCELERATE PROPERLY" above
	Bearing failure in gas producer section	Locate and repair
	Improperly installed or unbalanced rotor assembly	Install rotor assembly properly, or replace rotor assembly
HOT STREAKS ON NOZZLE BOX ASSEMBLY	Loose burner shell clamps or improperly installed burner liner assemblies	Tighten clamps or adjust position of burner liner assemblies in burner shell assemblies
REDUCED COMPRESSOR AIR FLOW	Leakage around first- or second-stage tube assemblies	Tighten clamps or replace faulty O-ring gaskets
	Defective air flow controller	Replace air flow controller

T. O. 38G2-54-3

Section VIII
Paragraphs 8-24 to 8-25

8-24. INSTALLATION OF ENGINE.

8-25. INSTALLATION IN POWER PACKAGE. The engine assembly should be installed in the power package in the following manner:

a. Attach pin-insert-electrical-connector to left, inner side of left-hand ignition coil bracket, using four mounting screws and four lock nuts. Position wiring in front of engine so that tagged terminals are in position for attachment.

b. Clamp wires from pin-insert-connector together, attaching clamp beneath inner mounting nut which attaches left-hand igniter coil to its bracket.

c. Attach three wires (see wiring diagram on inlet door of power package) (J1A10), (J1B10) and (J1C10) to side (glow coil) terminal on left-hand vapor spark plug, using screw and nut.

d. Attach four ground wires (Q6A18N), (J2B10N), (E15A18N) and (P14A00N) under head of left top screw and washer attaching end plate of starter-generator to starter assembly.

NOTE

The heavy ground wire (P14A00N) should be routed underneath the acceleration limiter and the remaining three wires should be routed over the relief valve attached to rear of acceleration limiter.

e. Attach electrical connectors to fuel solenoid and tachometer generator.

f. Attach ground wire (E15A18N) to upper right mounting stud of tachometer generator, securing terminal beneath nut.

g. Clamp all ground wires and wires to fuel solenoid and tachometer generator together, and attach clamp to upper boss on left side of acceleration limiter. Secure ends of clamp beneath head of bolt.

h. Place one clamp around starter-generator cable to junction box and another clamp around all other wires routed to top of engine and secure both clamps together on left-hand burner elbow bracket.

i. Attach glow coil cable (J1C10) to left-hand igniter coil by inserting cable in end of case and attaching it to short terminal. Attach cover to case using four washers, lock washers and filister head screws. Screw knurled nut, through which cable passes, onto case boss.

j. Attach two ground wires (J2A10N) and (J2B10N) to front of left-hand ignition coil bracket, securing terminals beneath coil inner mounting lock nut.

k. Clamp remaining wires to bottom rear of gas producer compressor, attaching clamp beneath head of compressor housing fastening bolt.

l. Attach ground-jumper wire (J2A10N) beneath coil inner mounting nut on front of right-hand ignition coil bracket.

m. Clamp all remaining wires, including glow coil cable (J1D10) to right-hand vapor spark plug, to front of right-hand ignition coil bracket. Attach this clamp beneath head of upper mounting bolt for oil pressure switch bracket.

n. Install glow coil cable (J1D10) inside right-hand ignition coil assembly in same manner as for left-hand ignition coil assembly. (See step i, above.)

o. Attach three terminal wires on oil pressure switch by attaching wire (W5A18) to common (center) terminal, wire (W7A18) to "S" terminal and wire marked "W4A18" to "O" terminal.

p. Attach two wires (J1D10) and J2A10) to side (glow coil) terminal on right-hand vapor spark plug assembly, using screw, washer and nut.

q. Clamp igniter lead assembly to side of left-hand ignition coil bracket, securing clamp with bolt and nut. Clamp right-hand igniter lead assembly to tube assembly, which carries air pressure from air flow controller to gage, securing double clamp with bolt and nut.

r. Install oil cooler transition assembly on two-stage compressor using eight washers and eight bolts.

s. Remove engine mounting bolts, spacers and nuts from Lord Mount brackets and attach hoisting sling to front and rear hoist fittings located on top of gas producer and two-stage compressor. Hoist engine over cubicle and very carefully lower into position, taking care that mounting brackets on engine slip down over Lord Mounts in engine mount brackets in cubicle. Keeping strain on hoist, secure engine to cubicle, using six Lord Mount spacers, three bolts and three nuts.

t. (See figure 4-1.) To install front silencer assembly (with the engine installed), remove adapter flange by removing eight screws (2). Place bell of silencer assembly through rubber grommet in air inlet compartment access panel. Attach adapter flange (1) to silencer assembly by installing eight screws. Insert air silencer and access panel through front of air inlet compartment and secure eight fasteners.

u. Push both air inlet silencer assemblies inward at two-stage compressor end and gas producer end and attach inlet silencer assemblies to engine. Attach front panel of air inlet compartment at front end of cubicle, using 10 flat head and 13 round head screws. Attach front panel of air inlet compartment at two-stage compressor end of cubicle using 13 flat head and 6 round head screws.

v. Screw electrical-socket-insert-connector into pin-insert-connector in left-hand ignition coil bracket.

w. Attach oil sump drain hose assembly to tee fitting on left-hand side of sump and base.

x. Install starter-cable wires by inserting in junction box and attach wire (P11A10) to "A" terminal, wire (P12A18) to "F" terminal, and wire (P10A0) to "B" terminal. Tighten cable spanner nut to junction box.

y. Attach check valve end of air flow control assembly to air discharge assembly using connector assembly.

z. Attach scavenge pump-to-cooler inlet hose assembly to nipple at scavenge outlet of lube and scavenge pump.

aa. Attach oil pressure hose assembly, between pressure outlet of lube and scavenge pump and junction, to inner 90° elbow in junction on frame near oil pressure switch.

bb. Place clamps around junction-to-fuel pump hose assembly, and acceleration limiter-to-junction hose assembly, and fasten clamps together on bracket on right-hand burner elbow, using screw and nut.

cc. Slip two clamps around two hose assemblies (acceleration limiter-to-junction, and junction-to-fuel pump) and secure one clamp beneath nut for left-hand attaching bolt of front hoist fitting and secure other clamp beneath nut of gas producer compressor

housing fastening bolt, located just to right of front hoist fitting.

dd. Attach junction-to-fuel pump hose assembly to tee fitting at fuel pump inlet.

ee. Attach acceleration limiter drain hose assembly to nipple in center port on front of acceleration limiter.

ff. Attach fuel pump drain line to 90° elbow near bottom right side of sump and base.

gg. Attach nozzle box drain tube assembly to 90° elbow beneath nozzle box near right side of sump and base.

hh. Attach exhaust tube assembly to bypass valve assembly (of air flow control assembly) using connector assembly. Attach top of exhaust tube assembly to right-hand exhaust collector shell assembly with clamp secured around exhaust collector shell.

ii. Attach rod assembly to governor speed adjusting lever by inserting stud at end of rod through speed adjusting lever and securing stud with nut.

jj. Attach junction box to front of rear hoist fitting using two screws and two nuts.

kk. Attach chromel-alumel wires from exhaust temperature pyrometer to two top terminals on junction box (white terminal on left and green terminal on right side). Put two clamps around these wires and attach clamp to each second-stage tube on right side of two-stage compressor, securing clamps with two nuts and two screws.

ll. Attach air collector thermocouple terminal wires to terminal block on frame next to battery with yellow terminal on left and black terminal on right.

mm. Attach hose assembly from outlet port in bottom of lube filter to cross at two-stage compressor end.

nn. Attach hose assembly between oil cooler and scavenge outlet of lube and scavenge pump to 90° elbow on top of cooler.

oo. Attach copper oil-pressure gage tube to union on end of hose assembly from cross fitting at aft end of two-stage compressor.

pp. Place battery in position in right side of power package so that positive terminal is toward front. Clamp battery in position by engaging tie rods in holding cross-piece and tightening two wing nuts. Attach battery plug to right side of battery.

qq. Lift removable enclosure assembly into position on power package and secure with four fasteners on base frame.

8-26. INSTALLATION IN SHIPPING CONTAINER. The engine should be installed in an engine shipping container in the following manner:

a. Determine that shipping container is clean and that rags, tools and other loose articles have been removed from container.

b. With engine mount brackets removed from frame, place engine sealing envelope, conforming to specification MIL-F-6060, Type II, over mounting frame in shipping container. Reinstall engine mount brackets, punching holes through envelope just large enough to install bolts which attach engine mount brackets to mounting frame in container.

c. Attach hoisting sling to front and rear hoist fittings on engine and tighten sling to support engine.

d. Hoist engine and carefully lower it into container. Secure engine mounts in three engine mount brackets, using three bolts, six spacers and three nuts.

e. Secure humidity indicator card, part number AN7514-1, to engine and place desiccant bags, conforming to specification MIL-E-5607A, symmetrically around engine. Secure bags so that they will not shift or tear during shipment.

f. Secure barrier material, conforming to specification JAN-B-121 over all sharp edges on engine.

g. Carefully seal envelope around engine leaving an opening of about two inches. Extract air from envelope using portable vacuum cleaner and seal final opening.

h. Place cover on shipping container and secure with attaching bolts.

i. Seal engine forms in water repellent envelope and attach envelope to exterior of shipping container.

8-27. LOW PRESSURE FUEL FILTER.

8-28. INSTALLATION. (See figure 4-1.) Install low pressure fuel filter (52) and its bracket in the following manner:

a. Attach low pressure fuel filter and bracket to frame in left rear side of power package, using four bolts, four washers and four lock nuts.

b. Screw 90° elbows securely into inlet and outlet ports of fuel pump so that open ends of elbows point down.

c. Attach tube assembly from manual fuel valve to front elbow on filter. Attach tube assembly to fuel pump inlet to other elbow in filter. Tighten tube fittings.

8-29. LUBE FILTER.

8-30. INSTALLATION. (See figure 4-1.) Install lube filter and its mounting bracket assembly to frame in left rear side of power package in the following manner:

a. Attach filter and bracket to frame of power package using four bolts, four washers and four nuts.

b. Screw nipple in side boss of filter and screw reducer bushing into bottom boss of filter. Screw 45° elbow into bushing.

c. Attach tube assembly from lube and scavenge pump hose assembly from cross at compressor end of engine to filter. Tighten elbow and all fittings.

8-31. VOLTAGE REGULATOR AND STARTER RELAY.

8-32. INSTALLATION. (See figure 4-1.) The voltage regulator and starter relay should be installed in the electrical equipment box in the bottom of the power package in the following manner:

a. Place voltage regulator in electrical equipment box, base down, with terminal posts pointed toward center of power package and secure base to bottom of box with four bolts.

b. Attach terminal wire tagged "F" (from field winding of starter-generator) to terminal post "F" on voltage regulator.

c. Attach terminal wire tagged "A" (from armature winding of starter-generator) to terminal post "A" on voltage regulator.

d. Attach wire tagged "B" (from battery) to terminal

post "B" on voltage regulator.

e. Place starter relay in bottom of electrical equipment box and secure with two nuts and two bolts.

f. Attach negative ground wire to terminal X or starter relay. Attach wire marked P8B-18 (from start switch) to terminal X2. Attach wire marked P4C-00 (from battery) to terminal A2.

g. Replace equipment box cover over voltage regulator and starter relay and secure with four screws.

8-33. EXHAUST TERMPERATURE PYROMETER.

8-34. INSTALLATION. (See figure 4-1.) Install the exhaust temperature pyrometer on the instrument panel in the following manner:

a. Secure pyrometer at top right side of instrument panel using three screws.

b. Attach wire marked (E60-18) to terminal post marked "CONT."

c. Attach green wire marked (E4A-20) and wire marked (E17-18N) to terminal post marked "ALUM."

d. Attach wire marked (EA2-20) to terminal post marked "CHROM."

8-35. TACHOMETER INDICATOR.

8-36. INSTALLATION. (See figure 4-1.) Secure the tachometer-indicator on the instrument panel with 4 screws and secure electrical connector to rear of indicator.

8-37. ENGINE TEST IN POWER PACKAGE.

8-38. TESTING. After reinstallation in the power package the engine should be tested in the following manner:

a. Start engine and check that idling speed is between 14,800 and 15,000 rpm. If necessary adjust low speed stop on fuel pump and governor assembly.

b. Operate engine at idle speed and inspect engine components for fuel, oil or air leakage.

c. Observe that all gages are operating normally as shown in table XVI.

d. Advance throttle control knob quickly to full throttle position. Engine should accelerate from 15,000 rpm to 35,000 rpm in four seconds. If speed does not increase to 35,000 rpm within specified time limit, shut down engine and adjust acceleration limiter as follows:

1. Remove lock wire and loosen lock nut which secures lower adjusting screw acceleration limiter.

2. Start engine and turn lower adjusting screw counterclockwise (from below) to increase acceleration time, or in clockwise direction to decrease acceleration time. Maximum amount of adjustment possible is four complete turns from a position flush with lock nut.

3. Install lockwire per specification MIL-W-6713 and Military Standard 33541.

NOTE

Do not attempt to adjust acceleration limiter by turning upper adjusting screw.

e. Move throttle control knob quickly from full throttle to idle position. If flameout occurs, shut off "DC POWER" switch immediately, and readjust minimum flow valve on fuel pump and governor assembly by opening very slightly, until flameout ceases to occur during rapid deceleration.